AIR CONDITIONER

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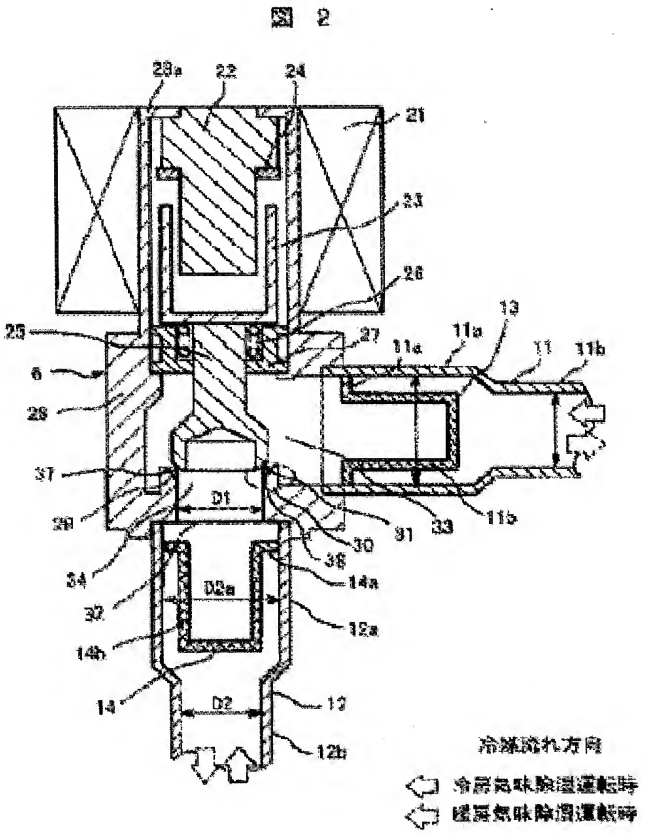
Abstract of **JP2002350003**

PROBLEM TO BE SOLVED: To obtain an appropriate restricting function easily and stably for a long period by using a restricting device for dehumidification of a simple structure and also to reduce a pressure loss of refrigerant piping in cooling and heating operations while sharply decreasing a flow sound of a refrigerant in a dehumidifying operation. SOLUTION: The restricting device 6 for dehumidification is constituted of an opening-closing restrictor which is put in a state of opening in the cooling and heating operations and makes a first indoor heat exchanger 5a and a second indoor heat exchanger 5b, divided in two, communicate with each other, while it is put in a state of restriction in the dehumidifying operation and makes the first and second indoor heat exchangers 5a and 5b communicate with each other. An enlarged-diameter part 11a of piping is provided in the portion of the refrigerant piping connected to the device 6 which turns to be on the upstream side in the dehumidifying operation, while a porous member 13 is provided in a refrigerant passage in the part 11a.



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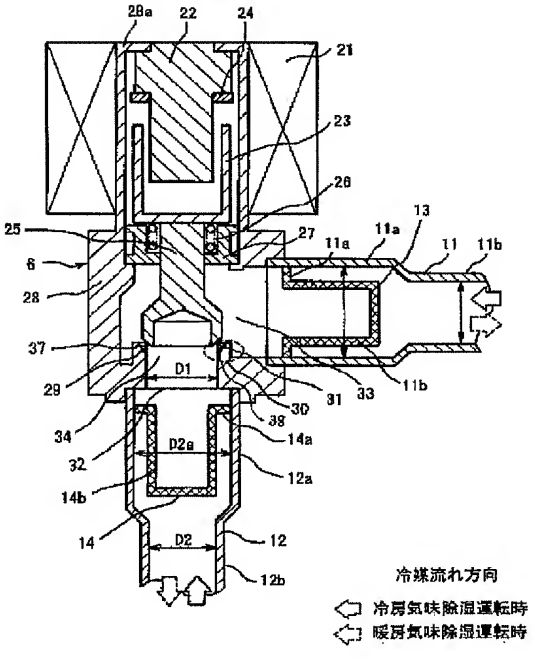
(54)【発明の名称】　空気調和機

(57)【要約】
【課題】空気調和機において、簡単な構成の除湿用絞り装置で適切な絞り作用を容易にかつ長期間安定して得ると共に、除湿運転時の冷媒流動音を大幅に低減しつつ冷暖房運転時における冷媒配管の圧力損失を抑制する。
【解決手段】冷房運転時及び暖房運転時に開状態にして２分割された第１室内熱交換器５ａと第２室内熱交換器５ｂとの間を連通すると共に除湿運転時に絞り状態にして２分割された第１室内熱交換器５ａと第２室内熱交換器５ｂとの間を連通する開閉絞り弁で除湿用絞り装置６を構成し、除湿用絞り装置６に接続する冷媒配管の除湿運転時に上流側となる部分に配管径拡大部１１ａを設けると共に、この配管径拡大部１１ａ内の冷媒流路中に多孔部材１３を設置する。

図 2



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【特許請求の範囲】

【請求項１】圧縮機と、熱源側熱交換器と、熱的に２分割された利用側熱交換器と、前記熱源側熱交換器と前記利用側熱交換器との間に配置されて冷房運転時及び暖房運転時に絞り作用を行なう冷暖房用絞り装置と、前記２分割された利用側熱交換器の間に配置されて除湿運転時に絞り作用を行なう除湿用絞り装置と、前記圧縮機と前記熱源側熱交換器及び前記利用側熱交換器との間に配置されて冷媒の流れを切換える四方弁と、を冷媒配管で接続して冷凍サイクルを形成し、

前記除湿用絞り装置は、冷房運転時及び暖房運転時に開状態にして前記２分割された利用側熱交換器の間を連通すると共に、除湿運転時に絞り状態にして前記２分割された利用側熱交換器の間を連通する開閉絞り弁で構成し、

前記除湿用絞り装置に接続する冷媒配管は、少なくとも除湿運転時に上流側となる冷媒配管に配管径拡大部を設けると共に、この配管径拡大部内の冷媒流路中に多孔部材を設置したことを特徴とする空気調和機。

【請求項２】圧縮機と、熱源側熱交換器と、熱的に２分割された利用側熱交換器と、前記熱源側熱交換器と前記利用側熱交換器との間に配置されて冷房運転時及び暖房運転時に絞り作用を行なう冷暖房用絞り装置と、前記２分割された利用側熱交換器の間に配置されて除湿運転時に絞り作用を行なう除湿用絞り装置と、前記圧縮機と前記熱源側熱交換器及び前記利用側熱交換器との間に配置されて前記圧縮機から出た冷媒を前記熱源側熱交換器に導く冷房側サイクルと前記利用側熱交換器に導く暖房側サイクルとに切換える四方弁を冷媒配管で接続して冷凍サイクルを形成し、

前記冷凍サイクルは、冷房側サイクルにおける前記利用側熱交換器を蒸発器とし前記熱源側熱交換器を凝縮器とする冷房運転と、暖房側サイクルにおける前記利用側熱交換器を凝縮器とし前記熱源側熱交換器を蒸発器とする暖房運転と、前記冷房側サイクルにおける前記利用側熱交換器の一方を蒸発器とし他方を凝縮器とし前記熱源側熱交換器を凝縮器とする冷房気味除湿運転と、前記暖房側サイクルにおける前記利用側熱交換器の一方を凝縮器とし他方を蒸発器とし前記熱源側熱交換器を蒸発器とする暖房気味除湿運転と、に切換え可能な構成とし、

前記除湿用絞り装置は、冷房運転時及び暖房運転時に開状態にして前記２分割された利用側熱交換器の間を連通すると共に、冷房気味除湿運転時及び暖房気味除湿運転時に絞り状態にして前記２分割された利用側熱交換器の間を連通する開閉絞り弁で構成し、

前記除湿用絞り装置に接続する両側の冷媒配管は、配管径拡大部をそれぞれ設けると共に、これらの拡大部内の冷媒流路中に多孔部材をそれぞれ設置したことを特徴とする空気調和機。

【請求項３】圧縮機と、熱源側熱交換器と、熱的に２分割された利用側熱交換器と、前記熱源側熱交換器と前記利用側熱交換器との間に配置されて冷房運転時及び暖房運転時に絞り作用を行なう冷暖房用絞り装置と、前記２分割された利用側熱交換器の間に配置されて除湿運転時に絞り作用を行なう除湿用絞り装置と、前記圧縮機と前記熱源側熱交換器及び前記利用側熱交換器との間に配置されて冷媒の流れを切換える四方弁と、を冷媒配管で接続して冷凍サイクルを形成し、

前記除湿用絞り装置は、弁本体とこの弁本体内の通路を開閉する弁部とを有する開閉絞り弁で形成し、冷房運転時及び暖房運転時に前記弁部を開いた状態にして前記２分割された利用側熱交換器の間を連通すると共に、除湿運転時に前記弁部を閉じた絞り状態にして前記２分割された利用側熱交換器の間を連通するように構成し、

前記除湿用絞り装置に接続する冷媒配管は、少なくとも除湿運転時に上流側となる冷媒配管における前記弁本体への開口入口部に配管径拡大部を設けると共に、この配管径拡大部内の冷媒流路中に多孔部材を設置したことを特徴とする空気調和機。

【請求項４】請求項３において、前記多孔部材は、前記開閉絞り弁の閉じた状態で形成される絞り通路より小さい孔径を有するように形成したことを特徴とする空気調和機。

【請求項５】圧縮機と、熱源側熱交換器と、熱的に２分割された利用側熱交換器と、前記熱源側熱交換器と前記利用側熱交換器との間に配置されて冷房運転時及び暖房運転時に絞り作用を行なう冷暖房用絞り装置と、前記２分割された利用側熱交換器の間に配置されて除湿運転時に絞り作用を行なう除湿用絞り装置と、前記圧縮機と前記熱源側熱交換器及び前記利用側熱交換器との間に配置されて前記圧縮機から出た冷媒を前記熱源側熱交換器に導く冷房側サイクルと前記利用側熱交換器に導く暖房側サイクルとに切換える四方弁を冷媒配管で接続して冷凍サイクルを形成し、

前記冷凍サイクルは、冷房側サイクルにおける前記利用側熱交換器を蒸発器とし前記熱源側熱交換器を凝縮器とする冷房運転と、暖房側サイクルにおける前記利用側熱交換器を凝縮器とし前記熱源側熱交換器を蒸発器とする暖房運転と、前記冷房側サイクルにおける前記利用側熱交換器の一方を蒸発器とし他方を凝縮器とし前記熱源側熱交換器を凝縮器とする冷房気味除湿運転と、前記暖房側サイクルにおける前記利用側熱交換器の一方を凝縮器とし他方を蒸発器とし前記熱源側熱交換器を蒸発器とする暖房気味除湿運転と、に切換え可能な構成とし、

前記除湿用絞り装置は、弁本体とこの弁本体内の通路を開閉する弁部とを有する開閉絞り弁で形成し、冷房運転時及び暖房運転時に開状態にして前記２分割された利用側熱交換器の間を連通すると共に、冷房気味除湿運転時及び暖房気味除湿運転に絞り状態にして前記２分割された利用側熱交換器の間を連通するように構成し、

前記除湿用絞り装置に接続する両側の冷媒配管は、前記弁本体への開口出入口部に配管径拡大部をそれぞれ設けると共に、この配管径拡大部内の冷媒流路中に多孔部材をそれぞれ設置し、
前記多孔部材は、その周縁部を前記配管径拡大部の内周面に取り付けると共に、その中央部を反弁本体側に凸形状となるように形成したことを特徴とする空気調和機。
【請求項６】請求項５において、前記多孔部材は、その周縁部を前記配管径拡大部の内周面に取り付けるフランジ部と、その中央部から除湿運転時の上流側に傾斜面を有するように突出する凸形状部とを備えたことを特徴とする空気調和機。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、冷凍サイクルを用いて冷房、暖房および除湿運転を行なう空気調和機に係わり、特に利用側熱交換器を２分割してこれらの間に除湿用絞り装置を配置して除湿運転を可能とした空気調和機に好適なものである。
【０００２】
【従来の技術】従来の空気調和機としては、特開２０００－３４６４９５号公報（従来技術１）に示されているものがある。この空気調和機は、圧縮機、室外熱交換器、２分割された室内熱交換器、室外熱交換器と室内熱交換器との間に配置されて冷房運転時及び暖房運転時に絞り作用を行なう第1流量制御弁、２分割された室内熱交換器の間に配置されて除湿運転時に絞り作用を行なう第２流量制御弁、圧縮機と室外熱交換器及び室内熱交換器との間に配置されて圧縮機から出た冷媒を室外熱交換器に導く冷房側サイクルと室内熱交換器に導く暖房側サイクルとに切換える四方弁を冷媒配管で接続して冷凍サイクルを形成している。そして、この冷凍サイクルは、冷房側サイクルにおける利用側熱交換器を蒸発器とし熱源側熱交換器を凝縮器とする冷房運転と、暖房側サイクルにおける利用側熱交換器を凝縮器とし熱源側熱交換器を蒸発器とする暖房運転と、冷房側サイクルにおける利用側熱交換器の一方を蒸発器とし他方を凝縮器とし熱源側熱交換器を凝縮器とする冷房気味除湿運転と、暖房側サイクルにおける利用側熱交換器の一方を凝縮器とし他方を蒸発器とし熱源側熱交換器を蒸発器とする暖房気味除湿運転とに切換える構成となっている。また、この絞り装置は、第２流量制御弁の主弁体や主弁座を多孔質透過材で形成したり、電磁開閉弁と並列に接続され且つ内部に焼結金属を配置したりすることにより構成している。
【０００３】また、従来の空気調和機としては、特開平１１－３２５６５５号公報（従来技術２）に示されているように、空気調和機の冷凍サイクルの冷媒配管において、冷媒の乱れを整流及び均質化し、圧力脈動の伝達を抑制することにより、騒音の発生を低減することを目的として、冷暖房運転時に絞り作用を行なう膨張弁に接続される冷媒配管に細径管を複数本束ねたハニカムパイプを冷媒流通方向に間隔を空けて複数列挿入するようにしたものがある。そして、このハニカムパイプの代わりに多孔質金属や多孔質セラミックとしてもよい旨が示されている。
【０００４】また、従来の空気調和機としては、特開平１１－５１５１４号公報（従来技術３）に示されているように、冷凍サイクルにより室温の低下を防ぎながら除湿を行なう除湿運転において、冷媒流動音を低減し、必要除湿量を確保しつつ消費電力量を低減することを目的として、冷媒サイクルを形成する利用側熱交換器を熱的に２分割して第１、第２の利用側熱交換器として、該第１、第２の利用側熱交換器の間に除湿用絞り装置を設け、除湿運転時には、該除湿用絞り装置により、上流側となる該第１の利用側熱交換器を凝縮器として、下流側となる該第２の利用側熱交換器を蒸発器としてそれぞれ利用するようにした冷凍サイクルを備え、該除湿用絞り装置は、該第１の利用側熱交換器に連通した第１の冷媒通路に貫通する弁口と、該第２の利用側熱交換器に連通した第２の冷媒通路に貫通する開放口と、該弁口と該開放口とを結ぶ第３の冷媒通路が形成された弁座と、該第３の冷媒通路の開閉を行なう弁部を有する弁棒と該弁棒を可動させる弁可動部とから形成される除湿絞り弁とを有して、該弁棒が可動することによって該第３の冷媒通路を開閉する弁の構造をなし、該弁棒が該弁座に当接して該第３の冷媒通路を閉じたときには、該弁棒と該弁座の壁面とで囲まれた独立した絞り通路を形成し、該弁棒と該弁座とが離れて該第３の冷媒通路を開いたときには、該独立した絞り通路が該第３の冷媒通路と一体になって該第３の冷媒通路の一部をなすように構成するものがある。
【０００５】
【発明が解決しようとする課題】一般に空気調和機において、冷媒が絞り装置を気液二相流の状態で流入すると冷媒流動音を発生させる。その音の大きさは、冷媒気液二相流の流動様式に起因し、特に流れに含まれる気泡の大きさに依存する。特に、絞り装置の絞り通路の大きさよりも気泡の大きさが大きいとき、その気泡が絞り通路を通過する際に変形し圧力脈動を発生させる。これが絞り装置を伝わり、空気調和機から冷媒流動音として放射される。このときに間欠的な冷媒流動音が発生し、快適性が損なわれる。このような冷媒流動音を低減するためには、絞り装置の絞り通路を通過する気泡はできるだけ小さい方が良く、特に絞り通路の大きさ以下の大きさであることが望ましい。
【０００６】従来技術１では、第２流量制御弁の主弁体や主弁座を多孔質透過材で形成して絞り装置としたり、電磁開閉弁と並列に接続し且つ内部に焼結金属を配置した絞り装置としたりしているが、この多孔質透過材また

は焼結金属自体の流通部に絞り作用を持たせているために、適用する空気調和機に合致した適切な絞り作用を多孔質部材及び焼結金属の孔の大きさや数で得ることが難しい場合があるという課題があった。そして、これらの孔の大きさや数のばらつきが空気調和機の除湿性能に大きく影響を与えこととなるが、この多孔質部材及び焼結金属の孔の大きさや数を均一に形成することが難しく、除湿性能のばらつきを招いてしまうという課題があった。また、主弁体や主弁座を多孔質部材で形成するものでは、主弁体と主弁座の接触部が長年の使用により変形を起こすおそれがあり、変形した場合にはその接触部から漏れによって絞り部の絞り量が当初の絞り量から変化してしまうという課題があった。さらに、多孔質透過材または焼結金属に冷凍サイクル内のゴミ等の汚れが付着して目詰まりが発生した場合にも、絞り量が大きくなってしまうという課題があった。

【０００７】また、従来技術２では、冷暖房運転時に絞り作用を行なう膨張弁にかかるものであって、除湿運転時に絞り作用を行なう除湿用絞り装置にかかるものではなく、除湿運転時に絞り作用を行なう除湿用絞り装置については全く開示されていない。また、従来技術２では、ハニカムパイプや多孔質金属や多孔質セラミックを冷媒流通方向に間隔を空けて複数列挿入するようにしているので、除湿運転可能な空気調和機の除湿用絞り装置に適用した場合には、冷房運転時及び暖房運転時にこの冷媒配管における圧力損失が大きくなり、空気調和機の冷房性能及び暖房性能が低下してしまうものである。

【０００８】また、従来技術３では、除湿運転における冷媒流動音の低減について記載されているが、流入する冷媒気液二相流の気泡の大きさと除湿用絞り装置との関係は開示されていないので、この関係を改善することによりさらに冷媒流動音を低減できる要因が残されている。

【０００９】本発明の目的は、一つの開閉絞り弁を用いるという簡単な構成の除湿用絞り装置で、冷房運転、暖房運転及び除湿運転が可能であると共に、適切な絞り作用を容易にかつ長期間安定して得ることができ、しかも除湿用絞り装置で発生する除湿運転時の冷媒流動音を大幅に低減しつつ、冷房運転時及び暖房運転時における冷媒配管の圧力損失を抑制して冷房性能及び暖房性能を向上できる空気調和機を提供することにある。

【００１０】

【課題を解決するための手段】上記目的を達成するために、本発明の代表的な発明の１つである空気調和機では、圧縮機と、熱源側熱交換器と、熱的に２分割された利用側熱交換器と、前記熱源側熱交換器と前記利用側熱交換器との間に配置されて冷房運転時及び暖房運転時に絞り作用を行なう冷暖房用絞り装置と、前記２分割された利用側熱交換器の間に配置されて除湿運転時に絞り作用を行なう除湿用絞り装置と、前記圧縮機と前記熱源側熱交換器及び前記利用側熱交換器との間に配置されて冷媒の流れを切換える四方弁と、を冷媒配管で接続して冷凍サイクルを形成し、前記除湿用絞り装置は、冷房運転時及び暖房運転時に開状態にして前記２分割された利用側熱交換器の間を連通すると共に、除湿運転時に絞り状態にして前記２分割された利用側熱交換器の間を連通する開閉絞り弁で構成し、前記除湿用絞り装置に接続する冷媒配管は、少なくとも除湿運転時に上流側となる冷媒配管に配管径拡大部を設けると共に、この配管径拡大部内の冷媒流路中に多孔部材を設置したものである。

【００１１】

【発明の実施の形態】以下、本発明の各実施例を図に基づいて説明する。なお、各実施例の図における同一符号は同一物又は相当物を示す。また、各実施例の空気調和機は建造物に設置するものである。

【００１２】本発明の第1実施例を図１から図３を用いて説明する。

【００１３】まず、この実施例の空気調和機の構成を図1を参照しながら説明する。図１は本発明の第1の実施例の空気調和機の冷凍サイクル構成図である。

【００１４】図1において、圧縮機１と、熱源側熱交換器である室外熱交換器３と、熱的に２分割された利用側熱交換器である室内熱交換器５と、室外熱交換器３と室内熱交換器５との間に配置されて冷房運転時及び暖房運転時に絞り作用を行なう冷暖房用絞り装置４と、２分割された室内熱交換器５の第１室内熱交換器５ａと第２室内熱交換器５ｂと間に配置されて除湿運転時に絞り作用を行なう除湿用絞り装置６と、圧縮機１と室外熱交換器３及び室内熱交換器５との間に配置されて圧縮機１から出た冷媒を室外熱交換器３に導く冷房側サイクルと室内熱交換器５に導く暖房側サイクルとに切換える四方弁２と、を冷媒配管で接続して冷凍サイクルが形成されている。

【００１５】また、かかる冷凍サイクルは、冷房側サイクルにおける室内熱交換器５を蒸発器とし室外熱交換器３を凝縮器とする冷房運転と、暖房側サイクルにおける室内熱交換器５を凝縮器とし室外熱交換器３を蒸発器とする暖房運転と、冷房側サイクルにおける第２室内熱交換器５ｂを蒸発器とし第１室内熱交換器５ａを凝縮器とし室外熱交換器３を凝縮器とした冷房気味除湿運転と、暖房側サイクルにおける第２室内熱交換器５ｂを凝縮器とし第１室内熱交換器５ａを蒸発器とし室外熱交換器３を蒸発器とする暖房気味除湿運転と、に切換え可能な構成とされている。

【００１６】そして、室外ファン７は室外空気を室外熱交換器３に強制的に通風するように設置されている。また、室内ファン８は室内空気を室内熱交換器５に強制的に通風するように設置されている。この室内ファン８の運転により、室内空気は第１室内熱交換器５ａと第２室内熱交換器５ｂに並列に吸込まれ、これから出た空気が

混合されて室内ファン８から室内に吹き出されるようになっている。

【００１７】また、配管径拡大部１１ａを有する配管部材１１及び配管径拡大部１２ａを有する配管部材１２は、配管径拡大部１１ａ及び配管径拡大部１２ａ内の冷媒流通路に多孔部材１３、１４が設置されている。ここで、多孔部材１３、１４は、焼結金属などで作られた多数の小孔の開いた部材で、各々の小孔は連結しており、冷媒を通すことが可能である。

【００１８】この実施例は、上述したように、圧縮機１と四方弁２と室外熱交換器３と冷暖房用絞り装置４と室内熱交換器５とが順に冷媒配管で接続されて冷凍サイクルが形成されている。特に、室内熱交換器５は、２つの第１室内熱交換器５ａ及び第２室内熱交換器５ｂに分割され、それらの間にこの実施例の特徴をなす除湿用絞り装置６とその前後に多孔部材１３、１４を内含した配管部材１１、１２が設けられている。

【００１９】さらに具体的に説明すると、四方弁２は、冷房・冷房気味除湿運転時と暖房・暖房気味除湿運転時とで、この冷凍サイクルでの冷媒の流れ方向を切換えるためのものであり、実線矢印は冷房運転時の冷媒の流れ方向を、破線矢印は暖房運転時の冷媒の流れ方向を、一点鎖線矢印は冷房気味除湿運転時の冷媒の流れ方向を、二点鎖線矢印は暖房気味除湿運転時の冷媒の流れを各々示している。ここで冷房気味除湿運転とは、主として室内の温度を下げずに除湿を行なえる運転であり、暖房気味除湿運転とは、主として室温を上げつつ除湿が行なえる運転である。

【００２０】また、冷暖房用絞り装置４は、暖房運転時には、室外熱交換器３で室外空気から効果的に吸熱が行われるように、また、冷房運転時には、室内熱交換器５で室内空気から効果的に吸熱が行われるように、各々冷媒を減圧する作用をなし、除湿運転時には、かかる減圧作用が生じないようにするものである。このため、冷暖房用絞り装置４は、主絞り装置９と二方弁１０とが並列に配列されてなる構成をなしており、暖房、冷房運転時には、二方弁１０が閉じて冷媒が主絞り装置９を通過するようにし、除湿運転時には、二方弁１０が開いて冷媒がこの二方弁１０を通過するように制御される。なお、この冷暖房用絞り装置４は、一つの膨張弁としてもよく、例えば、冷房運転時、暖房運転時では、絞りとして機能し、除湿運転時の場合は全開の状態で使用するようにした膨張弁でもよい。

【００２１】除湿用絞り装置６は、暖房及び冷房運転時に開状態にあって、低圧力損失の冷媒通路となり、冷媒をそのまま通過させ、また、除湿運転時には、絞り弁として作用する。

【００２２】また、除湿用絞り装置６の前後に設けられた多孔部材１３、１４を内含した配管部材１１および１２は、冷房気味除湿運転時では、気液二相の冷媒流が多孔部材１３を内含した配管部材１１を通過する際に、除湿用絞り装置６の絞り通路よりも小さい気泡を含んだ流動様式に変換して、除湿用絞り装置６に流入させる。そして、暖房気味除湿運転時では、気液二相の冷媒流が多孔部材１４を内含した配管部材１２を通過する際に、除湿用絞り装置６の絞り通路よりも小さい気泡を含んだ流動様式に変換して、除湿用絞り装置６に流入させる。また、多孔部材１４を内含した配管部材１２は、冷房気味除湿運転時に除湿用絞り装置６を通過した冷媒流を整流して、冷媒流の乱れを減らす。そして、多孔部材１３を内含した配管部材１１は、暖房気味除湿運転時に除湿用絞り装置６を通過した冷媒流を整流して、冷媒流の乱れを減らす。

【００２３】その結果、除湿用絞り装置６の上流側に設けられた多孔部材１３または１４において、冷媒気液二相流中の気泡は除湿用絞り装置６の絞り通路よりも小さな気泡に変換され、除湿絞り通路６に流入するため、絞り通過時の圧力脈動を小さくでき、冷媒流動音を低減することができる。また。除湿用絞り装置６の下流側に設けられた多孔部材１４または１３において、除湿用絞り装置６を通過した気液二相流の流れを整流することにより、流れの乱れを小さくし圧力変動を低減させ、これもまた冷媒流動音の低減となる。このように、除湿用絞り装置６の上流側と下流側に設置した多孔部材１３、１４の相乗効果で冷媒流動音を大幅に低減することができる。より効果を大きいものとするには、多孔部材１３、１４の孔の大きさは、除湿用絞り装置６の絞り通路の大きさ以下であることが特に望ましい。

【００２４】そして、この実施例では、暖房運転時には、室外熱交換器３が室外空気から吸熱を行なう蒸発器となるのに対し、第１室内熱交換器５ａ及び第２室内熱交換器５ｂが室内に放熱する凝縮器とる。冷房運転時には、室外熱交換器３が凝縮器となるのに対し、第１室内熱交換器５ａ及び第２室内熱交換器５ｂが室内空気から吸熱する蒸発器となる。

【００２５】そして、冷房気味除湿運転時には、室外熱交換器３が冷房運転と同様に凝縮器となり、除湿用絞り装置６が絞り弁としての作用をすることから、上流側の第１室内熱交換器５ａが室内空気に放熱する凝縮器となり、下流側の第２室内熱交換器５ｂが室内空気から吸熱する蒸発器となる。ここで、第２室内熱交換器５ｂが吸熱することにより、室内空気が冷却されて除湿が行われるが、この空気の冷却を補償するように、第１室内熱交換器５ａで放熱が行われて室内空気が暖められ、この冷却された空気と暖められた空気とが混合されて室内に吹き出されることにより、快適な除湿効果が得られるのである。

【００２６】また、暖房気味除湿運転時には、室外熱交換器３が、暖房運転と同様、蒸発器となり、除湿用絞り装置６が絞り弁としての作用をすることから、上流側の

第２室内熱交換器５ｂが室内空気に放熱する凝縮器となり、下流側の第１室内熱交換器５ａが室内空気から吸熱する蒸発器となる。ここで、第１室内熱交換器５ａが吸熱することにより、室内空気が冷却されて除湿が行われるが、この空気の冷却を補償するように、第２室内熱交換器５ｂで放熱が行われて室内空気が暖められ、この冷却された空気と暖められた空気とが混合されて室内に吹き出されることにより、快適な除湿効果が得られるのである。このとき、冷房気味除湿運転と異なり、圧縮機１を出た高温の冷媒を直接室内の熱交換器５ｂに導いているため、吹き出し空気温度の高い除湿された空気を得ることができ、梅雨時や秋雨時などの比較的気温の低い時の除湿運転に有効である。

【００２７】図２は図１における除湿用絞り装置６の具体例を示す縦断面図である。図２において、２１は電磁コイル、２２は電磁ガイド、２３はプランジャ、２４は緩衝材、２５は弁部を構成する弁棒、２６はバネ、２７はストッパ、２８は弁本体、２８ａは筒状部、２９は切り込み溝、３０は弁座、３１は弁口、３２は開放口、３３、３４は弁室、３７は弁棒端面である。なお、図２に示す除湿用絞り装置６およびそれを用いた空気調和機は、冷凍サイクルにより室温の低下を防ぎながら除湿を行なう除湿運転において、冷媒流動音を低減させ、かつ必要除湿量を確保しつつ消費電力量を低減できるとして前述した特開平１１－５１５１４号公報において開示されている。

【００２８】図２で明らかなように、弁本体２８は２つの弁室３３、３４が設けられており、冷房気味除湿運転時には、弁室３３が冷媒の高圧側となり、弁室３４が冷媒の低圧側となり、また暖房気味除湿運転時には、弁室３４が冷媒の高圧側となり、弁室３３が冷媒の低圧側となる。そして、弁室３３に第１室内熱交換器５ａ（図１参照）からの冷媒配管１１が連結され、弁室３４に第２室内熱交換器５ｂ（図１参照）からの冷媒配管１２が連結されている。冷房気味除湿運転時には、冷媒配管１１が冷媒の入口配管となって弁室３４が低圧側となる。また暖房気味除湿運転時には、冷媒配管１２が冷媒の入口配管となって弁室３３が低圧側となる。この弁室３３内には、弁棒２５が、図面上で上下方向に移動可能に設けられている。

【００２９】弁本体２８には、筒状部２８ａが一体に設けられ、その内部の、図面上で上部に電磁ガイド２２が、同じく下部にストッパ２７が各々設けられ、これらの間に弁棒２５と一体となったプランジャ２３が配置されている。このプランジャ２３は筒状をなしており、この筒状部が電磁ガイド２２の突出部と筒状部２８ａとの間に配置されている。電磁ガイド２２でのプランジャ２３の先端部に対向する部分に緩衝材２４が設けられており、電磁ガイド２２のこの緩衝材２４が設けられた部分がプランジャ２３に対する他方のストッパとなっている。また、このプランジャ２３は、ストッパ２７に固定されたバネ２６によって上方、即ち、電磁ガイド２２の方向に付勢されている。さらに、筒状部２８ａの外面側には、電磁コイル２１が設けられている。

【００３０】かかる構成により、電磁コイル２１に通電されると、電磁ガイド２２とプランジャ２３との間に電磁力が発生し、この電磁力とバネ２６の付勢力とがバランスした位置に、プランジャ２３と弁棒２５が上下に移動する。なお、除湿絞り弁の弁棒２５の駆動装置として、モーターを使用して駆動されるもの、機械的に駆動されるもの、感温筒を用いた圧力制御により駆動されるものが適用されてもよく、駆動方法については種々の構成のものが適用可能である。

【００３１】弁室３３、３４の境界では、弁室３３側に突出した弁座３０（図２中の破線部分）が形成されている。弁室３４は、この弁座３０の部分の弁室３３との境界を弁口３１とし、冷媒配管１２との接続部を開放口３２としている。弁棒２５の先端部は、弁座３０の弁口３１の径よりも若干大きい外径を有する筒状をなしており、また弁座３０には、１つ以上の切り込み溝２９が設けられている。なお、この絞り弁の切り込み溝形状は、Ｖ溝でも、円筒形溝でもなんでもよい。

【００３２】かかる構成において、電磁コイル２１に通電すると、電磁ガイド２２とプランジャ２３との間に発生する大きな電磁力により、バネ２６の付勢力に抗してプランジャ２３、従って、弁棒２５が押し下げられ、弁棒２５の先端が弁座３０に接触する。この時、弁棒２５と弁座３０の切り込み溝２９に囲まれた領域が冷媒絞り通路３７とし、弁室３３と弁室３４とを連通する。

【００３３】電磁コイル２１への通電を停止すると、上記の電磁力がなくなるため、弁棒２５はバネ２６の付勢力によって持ち上げられ、弁棒２５が弁座３０と離れる。これにより、弁口３１が開き、冷媒絞り通路３８はなくなって、弁室３３、３４が弁口３１によって連通する。

【００３４】このように、除湿絞り弁の構造をなすこの具体例は、少なくとも弁室３４の径Ｄ１と配管１２の径Ｄ２が同等以上であり、また少なくとも弁室３４の径Ｄ１と配管１１の径Ｄ３同等以上であれば、弁棒２５の全開時では、弁室３３から弁室３４への曲がりに伴う圧力降下による損失が生ずるのみであって、低圧力損失の冷媒通路を形成することになり、また、弁棒２５の全閉時では、冷媒絞り通路３８が形成されて、必要な圧力降下をもたらすことになる。

【００３５】そして、除湿用絞り装置６に接続する両側の冷媒配管１１、１２は、弁本体２８への開口出入口部に配管径拡大部１１ａ、１１ｂがそれぞれ設けられ、この配管径拡大部１１ａ、１１ｂ内の冷媒流路中に多孔部材１３、１４がそれぞれ設置されている。

【００３６】この多孔部材１３、１４は、周縁部を構成

するフランジ部１３ａ、１４ａと、このフランジ部１３ａ、１４ａの中央部から筒状に延びると共にその先端部に頂面部を有する凸形状部１３ｂ、１４ｂとからなっている。そして、多孔部材１３、１４は、そのフランジ部１３ａ、１４ａが配管径拡大部１１ａ、１２ａの内周面に取り付けられる。また、凸形状部１３ｂ、１４ｂは反弁本体側に突出するように配置されている。

【００３７】このように凸形状部１３ｂ、１４ｂとした多孔部材１３、１４には大きく２つの効果がある。まず第１の効果としては、多孔部材１３、１４を通過した後に、微細化された気泡が再度合体し大きな気泡とならないようにすることである。これは、多孔部材１３、１４の凸形状部１３ｂ、１４ｂの側面と配管径拡大部１１ａ、１２ａの内面との距離が狭くなるため、もし弁本体側に向けて凸状とした場合には、除湿運転時に凝縮器である熱交換器５ａ、５ｂから流出してくる二相流の冷媒が多孔部材１３、１４を通過してこの狭い領域に流出した微細化気泡に作用する拘束力が大きくなり、気泡同士が衝突し合体して大きな気泡に戻るおそれがある。これに対し、本実施例のように反弁本体側に凸形状とすることにより、除湿運転時に凝縮器である熱交換器５ａ、５ｂから流出してくる二相流の冷媒が多孔部材１３、１４を通過し、気泡が微細化された後に広い空間に流出することとなり、気泡同士の合体を防止することができる。

【００３８】第２の効果としては、凸形状部１３ｂ、１４ｂにできる鋭角なエッジによる気泡の細分化である。多孔部材１３、１４を上流側に凸形状とすると、多孔部材１３、１４の凸形状部１３ｂ、１４ｂの側面と配管径拡大部１１ａ、１２ａの内面との間に偏流が発生する。この時、多孔部材１３、１４の凸形状部１３ｂ、１４ｂにおけるエッジ部分では、気泡が鋭角に曲がれず、流れによるせん断力で、大きな気泡がちぎれ小さな気泡となる。この結果、大きな気泡は、多孔部材１３、１４のエッジによる細分化と多孔による微細化の２段階を経て、確実に微細気泡とすることができる。

【００３９】次に、この具体例の暖房運転、冷房運転および除湿運転時での動作を説明する。

【００４０】暖房、冷房運転時には、電磁コイル２１への通電は行われず、このため、弁棒２５は持ち上げられた状態にあって、弁室３３、３４とが広い面積の弁口３１で連通する。暖房運転時には、冷媒が第２室内熱交換器５ｂから、矢印とは逆方向に、冷媒配管１２、弁室３４、弁口３１、弁室３３を通って冷媒配管１１に流れ、第１室内熱交換器５ａに送られる。このとき、上記のように、室外熱交換器３（図１参照）は蒸発器として動作し、これら室内熱交換器５（図１参照）は凝縮器として動作する。また、冷房運転時には、冷媒が第１室内熱交換器５ａから、矢印方向に、冷媒配管１１、弁室３３、弁口３１、弁室３４を通って冷媒配管１２に流れ、第２室内熱交換器５ｂに送られる。このとき、上記のように、室外熱交換器３は凝縮器として動作し、これら第１室内熱交換器５ａ及び第２室内熱交換器５ｂは蒸発器として動作する。

【００４１】冷房気味除湿運転時には、電磁コイル２１への通電が行われ、除湿絞り弁内の弁棒２５が弁座３０に接触して弁口３１を閉鎖し、弁棒２５と弁座３０に設けられた切り込み溝２９とで囲まれた領域が冷媒絞り通路３８として形成され、この冷媒絞り通路３８を介して弁室３３、３４が連通される。このとき、冷媒は、冷房運転と同様の矢印方向に、冷媒配管１１から弁室３３、冷媒絞り通路３８、弁室３４及び冷媒配管１２を通して流れ、これらの冷媒絞り通路３８によって適正な圧力まで減圧される。その結果、弁室３３が高圧側となり、弁室３４が低圧側となる。そして、このときには、上記のように、室外熱交換器３が凝縮器であり、第１室内熱交換器５ａが凝縮器（再熱器）として、また、第２室内熱交換器５ｂが蒸発器（冷却器）として動作する。このようにして、第２室内熱交換器５ｂでは、室内空気を冷却しながら除湿を行なうが、第１室内熱交換器５ａで室内空気を加熱することになり、従って、室温の低下を防ぎながら除湿する除湿運転を行なうことが可能となる。

【００４２】同様に暖房気味除湿運転時には、電磁コイル２１への通電が行われ、除湿絞り弁内の弁棒２５が弁座３０に接触して弁口３１を閉鎖し、弁棒２５と弁座３０に設けられた切り込み溝２９とで囲まれた領域が冷媒絞り通路３８として形成され、この冷媒絞り通路３８を介して弁室３３、３４が連通される。このとき、冷媒は、暖房運転と同様の矢印方向に、冷媒配管１２から弁室３４、冷媒絞り通路３８、弁室３３及び冷媒配管１１を通して流れ、これらの冷媒絞り通路３８によって適正な圧力まで減圧される。その結果、弁室３４が高圧側となり、弁室３３が低圧側となる。そして、このときには、上記のように、室外熱交換器３が蒸発器であり、第１室内熱交換器５ａが蒸発器（冷却器）として、また、第２室内熱交換器５ｂが凝縮器（再熱器）として動作する。このようにして、第１室内熱交換器５ａでは、室内空気を冷却しながら除湿を行なうが、第２室内熱交換器５ｂで室内空気を加熱することになり、従って、室温の低下を防ぎながら除湿する除湿運転を行なうことが可能となる。

【００４３】また、この実施例では、室外ファン７の回転数を可変とし、室外熱交換器３での凝縮能力を変えることにより、あるいは圧縮機１の回転数を可変とし、圧縮機１の能力を変えることにより、第１室内熱交換器５ａでの凝縮能力、即ち、放熱量を変えて、室内ファン８による吹き出し空気の温度を冷房気味から暖房気味までの広い範囲にわたって制御することが可能である。

【００４４】さらに、第１室内熱交換器５ａ及び第２室内熱交換器５ｂは、室内から見て上下に並べ、室内ファン８により、室内空気を第１室内熱交換器５ａと第２室

内熱交換器５ｂとに分けて流す他に、室内からみて左右に並べるばかりでなく、室内からみて前後に並べ、室内ファン８により、室内空気を第２室内熱交換器５ｂ側から第１室内熱交換器５ａ側に流すようにしても良い。

【００４５】上述した実施例においては、冷房運転時及び暖房運転時に開状態にして２分割された第１室内熱交換器５ａと第２室内熱交換器５ｂとの間を連通すると共に除湿運転時に絞り状態にして２分割された第１室内熱交換器５ａと第２室内熱交換器５ｂとの間を連通する開閉絞り弁で除湿用絞り装置６を構成しているので、冷房運転時、暖房運転時及び除湿運転時の全てに除湿用絞り装置６を構成する開閉絞り弁を通して２分割された第１室内熱交換器５ａと第２室内熱交換器５ｂが連通されることとなり、電磁開閉弁に並列に絞り装置を設けているものと比較して、一つの開閉絞り弁を用いるという簡単な構成の除湿用絞り装置６で冷房運転、暖房運転及び除湿運転が可能である。そして、除湿用絞り装置６に接続する冷媒配管１１、１２における少なくとも除湿運転時に上流側となる冷媒配管１１、１２に配管径拡大部１１ａ、１１ｂを設けると共に、この配管径拡大部１１ａ、１１ｂ内の冷媒流路中に多孔部材１３、１４を設置しているので、多孔部材１３、１４が除湿運転時における絞り作用を行なう除湿用絞り装置６に対して独立していると共に、冷媒が流通する面積の大きい多孔部材１３、１４とすることができる。これにより、適用する空気調和機に合致した適切な絞り作用を除湿用絞り装置６により容易にかつ長期間安定して得ることができるので、所定の除湿性能を有する空気調和機を容易に且つ安定して得ることができる。しかも、多孔部材１３、１４の面積が大きくできることにより、多孔部材１３、１４の孔の大きさを小さくして冷媒の気泡の大きさを小さくすると共に、その孔の数を増やして冷媒の流通する抵抗を低減できるので、除湿用絞り装置６で発生する除湿運転時の冷媒流動音を大幅に低減することができると共に、冷房運転時及び暖房運転時における冷媒配管１３、１４の圧力損失を抑制することができる。

【００４６】また、冷房運転時及び暖房運転時に開状態にして２分割された第１室内熱交換器５ａと第２室内熱交換器５ｂとの間を連通すると共に冷房気味除湿運転時及び暖房気味除湿運転時に絞り状態にして２分割された第１室内熱交換器５ａと第２室内熱交換器５ｂとの間を連通する開閉絞り弁で除湿用絞り装置６を構成しているので、一つの開閉絞り弁を用いるという簡単な構成の除湿用絞り装置６で冷房運転、暖房運転、冷房気味除湿運転及び暖房気味除湿運転が可能である。そして、除湿用絞り装置６に接続する両側の冷媒配管１１、１２に配管径拡大部１１ａ、１２ａをそれぞれ設けると共に、これらの配管径拡大部１１ａ、１２ａ内の冷媒流路中に多孔部材１３、１４をそれぞれ設置しているので、適用する空気調和機に合致した適切な絞り作用を容易にかつ長期間安定して得ることができると共に冷房運転時及び暖房運転時における冷媒配管の圧力損失を抑制することができるという上述した効果を奏しつつ、冷房気味除湿運転時及び暖房気味除湿運転時の両方において、上流側の多孔部材１１、１２による除湿用絞り装置６での冷媒流動音の低減と、下流側の多孔部材１２、１１の整流作用による流動音の低減とを合わせて達成することができる。

【００４７】また、除湿運転時に除湿用絞り装置６の上流側となる冷媒配管１１、１２における弁本体２８への開口入口部に配管径拡大部１１ａ、１２ａを設けると共に、この配管径拡大部１１ａ、１２ａ内の冷媒流路中に多孔部材１３、１４を設置しているので、冷媒配管１１、１２の開口端部を拡管または開口端部から一側を縮管するのみで容易に配管径拡大部１１ａ、１２ａを形成することがでると共に、この配管径拡大部１１ａ、１２ａ内に多孔部材１３、１４を開口端部側から容易に挿入して設置することができ、しかも配管径拡大部１１ａ、１１ｂ及び多孔部材１３、１４を除湿用絞り装置６に最も近接して設けることができる。これにより、安価なものとすることができると共に、配管径拡大部１１ａ、１２ａから延びる冷媒配管１３、１４の引き回しを容易に行なうことができ、空気調和機内の狭い場所に除湿用絞り装置６を容易に設置することができる。

【００４８】また、多孔部材１３、１４は、その周縁部１３ａ、１４ａを配管径拡大部１１ａ、１２ａの内周面に取り付けると共に、その中央部を反弁本体側に凸形状となるように形成しているので、多孔部材１３、１４を通過した後に、微細化された気泡が再度合体し大きな気泡とならないようにすることができると共に、凸形状部１３ｂ、１４ｂにできるエッジによる気泡の細分化の促進を図ることができる。

【００４９】図２に示す除湿用絞り装置６の前後に図１に示した多孔部材１３、１４を内含した配管部材１１、１２を配置することで、除湿用絞り装置６に流入する冷媒気液二相流に含まれる気泡の大きさを制御できる。特に多孔部材の孔の大きさを冷媒絞り通路３８の大きさより小さくしているので、多孔部材１３、１４を通過時に変換される気泡の大きさを冷媒絞り通路の大きさより小さくでき、これにより圧力脈動を大幅に低減でき、図２の除湿用絞り装置６を単独で使用するときよりも、冷媒流動音を低減することが可能となる。

【００５０】次に、第１実施例における多孔部材１３、１４の変形例について図３を用いて説明する。

【００５１】この多孔部材１３、１４は、その周縁部を配管径拡大部１１ａ、１２ａの内周面に取り付けるフランジ部１３ａ、１４ａと、その中央部から除湿運転時の上流側に傾斜面を有するように円錐状に突出する凸形状部１３ｂ、１４ｂとを備えたものである。

【００５２】この第１変形例によれば、図２に示すものと比較して、配管径拡大部１１ａ、１２ａの内壁と多孔

部材１３、１４の凸形状部１３ｂ、１４ｂの側面との距離が中央部において離れているため、エッジの効果が小さくなるが、流れの衝突する面を大きくとることができるので、気泡を含む流れの衝突による多孔部材１３、１４での気泡微細化の効果を大きくできる。

【００５３】次に、本発明の第２実施例の空気調和機を図４から図１２を用いて説明する。図４は本発明の第２実施例による空気調和機の冷凍サイクル構成図、図５は同空気調和機の除湿用絞り装置部分の断面図である。

【００５４】この第２実施例は、除湿用絞り装置６に接続する冷媒配管１１、１２の除湿用絞り装置６から離れた中間部分に配管径拡大部１１ａ、１１ｂがそれぞれ設けられ、この配管径拡大部１１ａ、１１ｂ内の冷媒流路中に平坦な多孔部材１３、１４がそれぞれ設置されている点にて第１実施例と基本的に相違している。

【００５５】この第２実施例においても、第１実施例と共通する構成においては同じ効果を奏するものである。

【００５６】次に、第２実施例における多孔部材１３の変形例について図６から図１２を用いて説明する。この第２実施例における多孔部材１３の変形例は、第１実施例の多孔部材にも適用できると共に、第２実施例の多孔部材１４にも適用できるものである。

【００５７】図６及び図７は第２実施例の多孔部材１３の第１変形例を示す図である。この多孔部材１３は、配管軸方向にねじれた形状となっている。図６に示すように、配管部材１１内に多孔部材１３が取り付けられている。実線矢印は、ねじれた多孔部材１３の手前の冷媒の流れを示し、破線矢印はねじれた多孔部材の奥の冷媒の流れを示す。このとき、主たる冷媒の流れはねじれた多孔部材１３の形状に沿った流れ、例えば、実線矢印から破線矢印につながる流れ、となるが、多孔部材１３は冷媒を通すことができるので、一点鎖線の流れも存在する。実線矢印から破線矢印の流れで、ここを通る大きな気泡を含んだ流れは、旋回流にて気泡が細分化された流れとなる。また一点鎖線の流れにより、多孔部材を通過することで、気泡が微細化され、除湿用絞り装置の絞り通路の大きさより小さい気泡となる。これは多孔部材に衝突したり、流入した冷媒気液二相流は、その孔を通過する際にせん断力により大きな気泡が微細な気泡に分断し、衝突または流入した面とは別の面から冷媒流へ流出することで生じる。

【００５８】そして、図７に示すように、配管部材１１の断面積の内、多孔部材１３の断面積分だけが塞がれ、残りの部分は、冷媒通路１１ｃ、１１ｄ、１ｅ、１１ｆとして存在する。従って、配管部材１１は、少なくとも多孔部材１３の断面積分だけ配管部材１３の断面積が配管部分よりも大きくなるような配管径拡大部１１ａを有すれば、多孔部材１３が無い場合に比べ、冷房運転時および暖房運転時の圧力損失は大きくならないですむため、配管径拡大部１１ａが大きく成り過ぎなくてよい。また、冷媒通路１１ｃ、１１ｅは冷媒通路１１ｄ、１１ｆにつながっている。このため、たとえ多孔部材１３が目詰まりを起こしたとしても、冷媒の流れる通路は確保されており、またねじれ形状により生じる旋回流による気泡の細分化機能は維持されるので、空気調和機の機能も維持でき、さらに冷媒流動音も除湿用絞り装置単独で使用する場合よりは小さくなる。なお、ねじりの量は最低ひとひねり、即ち１８０度のひねり以上があれば有効である。

【００５９】図８及び図９は第２実施例の多孔部材１３の第２変形例を示す図である。この多孔部材１３は配管部材１１の配管径拡大部１１ａ内に千鳥に配置されている。多孔部材１３は配管径拡大部１１ａの断面の一部分を占めているが、全てを覆っておらず、冷媒通路１１ｇが確保されている。このとき冷媒の主たる流れは、図８における実線矢印となるが、多孔部材１３ａ～１３ｅが千鳥配置されているため、冷媒通路は蛇行しており、流れの向きを変えるときに大きな気泡は流れのせん断力により細分化される。また破線の流れにより、多孔部材を通過することで、気泡が微細化され、除湿用絞り装置の絞り通路の大きさより小さい気泡となる。これは、冷媒気液二相流が多孔部材１３に衝突し流入し、小孔を通過する際にせん断力により大きな気泡が微細な気泡に分割され、衝突した面とは異なる面から冷媒流に流出することで生じる。また多孔部材１３が千鳥に配置されているため、冷媒の主流は、蛇行した流れとなり、多孔部材１３の端部のエッジでせん断力により気泡が分断される効果もある。この効果はたとえ多孔部材１３が目詰まりをしても維持されるので、冷媒流動音も除湿用絞り装置単独で使用する場合よりは小さくなる。また冷媒通路は必ず確保されるので、空気調和機の機能も維持できる。このとき配管部材５０は、少なくとも配管部材の断面を覆っている多孔部材１３の面積分だけ配管部材の断面積が配管部分よりも大きくなるような配管径を有すれば、多孔部材１３が無い場合に比べ、冷房運転時および暖房運転時の圧力損失は大きくならないですむため、配管径拡大部１１ａが大きく成り過ぎなくてすむ。

【００６０】図１０は第２実施例の多孔部材１３の第３変形例を示す図である。この多孔部材１３は、第１変形例及び第２変形例の多孔部材１３で奏する効果を相乗させた効果を得るためのものである。この多孔部材１３は、多孔部材１３は十文字形状になっており、４５度角度を変えて軸方向に複数個連ねて配置することで効果を大きなものとしている。

【００６１】上述した第１から第３変形例の多孔部材１３の配置では、冷媒の流れる配管の断面積の全てを多孔部材１３で塞いでいないため、たとえ多孔部材１３にゴミやコンタミが付着し目詰まりを起こした場合でも、冷媒は流れて除湿用絞り装置に流入するため、空気調和機の機能は損なわれずに、性能もほぼ維持できる。

暖房運転及び除湿運転が可能であると共に、適用する空気調和機に合致した絞り作用を容易にかつ長期間安定して得ることができ、しかも除湿用絞り装置で発生する除湿運転時の冷媒流動音を大幅に低減しつつ、冷房運転時及び暖房運転時における冷媒配管の圧力損失を抑制して冷房性能及び暖房性能を向上できる空気調和機が得られる。

【図面の簡単な説明】

【図１】本発明の第１実施例の空気調和機のサイクル構成図であるである

【図２】同空気調和機の除湿用絞り装置部の断面図である。

【図３】同空気調和機の多孔部材の変形例を有する除湿用絞り装置部の断面図である。

【図４】本発明の第２実施例の空気調和機のサイクル構成図であるである

【図５】同空気調和機の除湿用絞り装置部の断面図である。

【図６】同空気調和機の多孔部材の第１変形例を示す配管径拡大部の断面図である。

【図７】同配管径拡大部のＡ－Ａ断面図である。

【図８】同空気調和機の多孔部材の第２変形例を示す配＊管径拡大部の断面図である。

【図９】同配管径拡大部の中央断面図である。

【図１０】同空気調和機の多孔部材の第３変形例を示す配管径拡大部の断面図である。

【図１１】同空気調和機の多孔部材の第４変形例を示す配管径拡大部の断面図である。

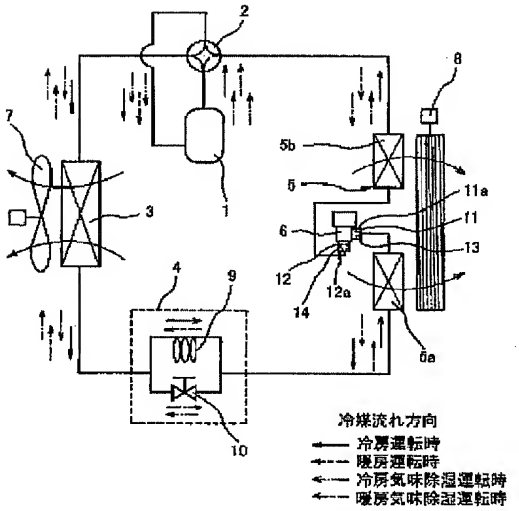
【図１２】同空気調和機の多孔部材の第５変形例を示す配管径拡大部の断面図である。

【符号の説明】

１…圧縮機、２…四方弁、３…室外熱交換器（熱源側熱交換器）、４…冷暖房用絞り装置、５…室内熱交換器（利用側熱交換器）、５ａ…第１室内熱交換器、５ｂ…第２室内熱交換器、６…除湿用絞り装置、７…室外ファン、８…室内ファン、９…主絞り装置、１０…二方弁、１１、１２…多孔部材を内含した配管部材、１１ａ、１２ａ…配管径拡大部、１３、１４…多孔部材、２１…電磁コイル、２２…電磁ガイド、２３…プランジャ、２４…緩衝材、２５…弁棒（弁部）、２６…バネ、２７…ストッパ、２８…弁本体、２９…切り込み溝、３０…弁座、３１…弁口、３２…開放口、３３、３４…弁室、Ｄ２、Ｄ３…配管内径、Ｄ２ａ、Ｄ３ａ…除湿用絞り装置内の拡大部の径。

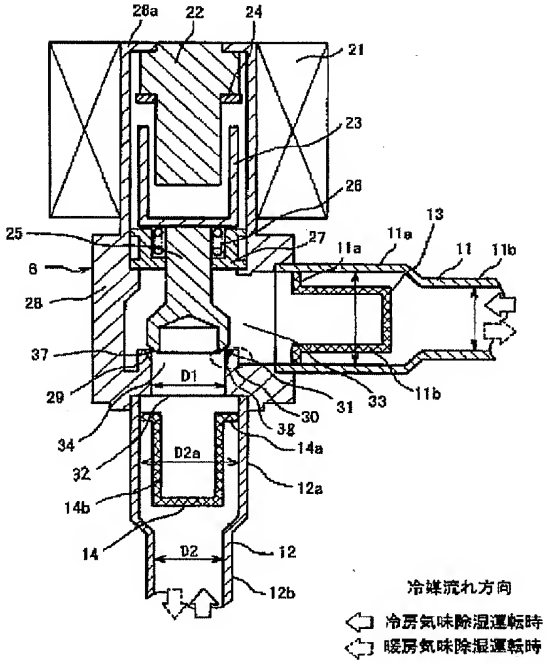
【図１】

図 1



【図２】

図 2



【００６２】なお、第１及び第３実施例の多孔部材１３に焼結金属を使用する場合は、例えばねじれ形状の型や十文字形状の型を用意し製作する。

【００６３】図１１は第２実施例の多孔部材１３の第４変形例を示す図である。この多孔部材１３は、多孔部材１３により管路断面を全て覆うため、冷房・暖房運転時において、圧力損失が大きく成る要因がある。そこで、多孔部材１３を設ける配管部材の径を大きくするとともに、多孔部材１３の流れ方向上流側の表面積が、拡大配管部材１１の上流側の配管部１１ｂの断面積よりも大きくするように凸形状の形とする。またこの時、多孔部材１３を通過した後、微細化された気泡が再度合体し大きな気泡とならないように、上流側に向かい凸形状とする。これは冷媒流と多孔部材１３との衝突の効果による気泡微細化にも利用される。

【００６４】図１２は第２実施例の多孔部材１３の第５変形例を示す図である。この多孔部材１３は、第４変形例の多孔部材１３の凸形状を円錐状にしたものである。これにより、第１実施例の変形例の多孔部材１３と同様の効果を奏することができる。

【００６５】なお、第１実施例及び第２実施例の冷凍サイクルにおいて、アキュムレータを圧縮機１の吸入側（第２室内熱交換器５ｂと圧縮機１の間）に設けても良く、使用する圧縮機１の種類あるいは冷暖房用絞り装置４の種類や制御方法によってはアキュムレータ付きの冷凍サイクルの構成とすることができる。また、レシーバを室外熱交換器３と冷暖房用絞り装置４との間に設けても良く、使用する圧縮機１の種類あるいは冷暖房用絞り装置４の種類や制御方法によってはレシーバ付きの冷凍サイクルの構成とすることができる。

【００６６】そして、冷凍サイクル内を流れる冷媒の種類としては、空気調和機で一般的に使用されているＨＣＦＣ２２等の単一冷媒、オゾン層破壊や地球温暖化の点からＨＣＦＣ２２に代わる代替冷媒の一つである混合冷媒（例えば、Ｒ４０７Ｃ、Ｒ４１０ＡやＲ３２）を使用することができる。特にＲ４１０ＡやＲ３２などの高圧冷媒の場合、その冷媒の物性により、冷媒流量がＲ２２等の使用時に比べＲ４１０Ａでは約７０％、Ｒ３２では約６０％とできるため、圧力損失が下がり、除湿用絞り装置の前後に多孔部材１３を設けても圧力損失が大きくならないため、例えば多孔部材１３を設ける配管部材の配管径をＲ２２使用時ほど大きくしないでもよい。また、代替冷媒の一つであるＨＦＣ系冷媒の場合には、塩素原子を有しないため極性を強く持っている。従って、使用される冷凍機油もＨＦＣ系冷媒と溶解する極性をもつ冷凍機油が使用される。しかし、空気調和機の製造工程や現地での設置において、冷凍サイクル内にコンタミ等の不純物が残留する。コンタミの多くは非極性物質である。また圧縮機内部の高温部等で反応性の高い不純物や冷凍機油に含まれている添加物が反応し、非極性物質であるスラッジを形成する。これらの非極性物質が液冷媒中に析出し、冷凍サイクル内で堆積することがある。特に絞り等の狭い冷媒絞り通路で堆積しやすい。これらの何れの場合においても、前述の多孔部材１３の形状の実施例を適用することで、多孔部材１３を配置した配管の詰まりも解決でき、空気調和機の機能を維持できる。また、冷媒として自然系冷媒（ＨＣ冷媒）を使用することができる。自然系冷媒（ＨＣ冷媒）には、例えば、プロパン、イソブタン、CO_2（二酸化炭素）などがある。

【００６７】また、上記の各実施例では、建屋の空気調和機を想定して説明したが、これに限らず、除湿運転が必要な他の用途の装置にも適用可能である。このような場合は、一般に熱交換器を室内あるいは室外に用いられるとは限られず、この場合は、室内熱交換器は利用側熱交換器、室外熱交換器は熱源側熱交換器、室内ファンは利用側ファン、室外ファンは熱源側ファンと呼ぶ。

【００６８】また、圧縮機の種類も圧縮機回転数を変化させる制御を使用しない場合では、一定速回転機のものでも同様な効果が得られる。

【００６９】本発明で多孔部材とは、例えば焼結金属、発泡金属、金網（メッシュ）、ハニカム板、多孔の開いた板がある。

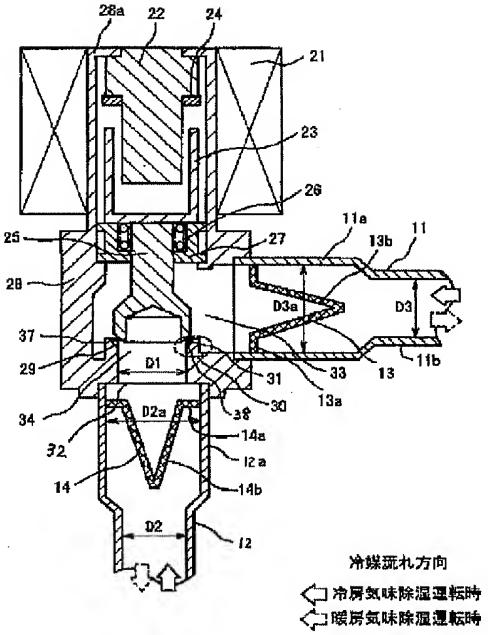
【００７０】以上説明したように、各実施例の空気調和機によれば、室内熱交換器（利用側熱交換器）を二分割してそのあいだに除湿運転時に使用する除湿用絞り装置を設け、除湿運転時に、利用側熱交換器の一方を蒸発器、他方を凝縮器として冷凍サイクルにより空気の冷却・除湿及び加熱を行なう冷凍サイクルにおいて、除湿用絞り装置の前後に、多孔部材を内含した配管部材を設け、多孔部材の孔の最大の大きさを除湿用絞り装置の冷媒絞り通路の大きさ以下にすることで、除湿用絞り装置の上流側の多孔部材を通過すると、冷媒気液二相流の気泡の大きさを除湿用絞り装置の絞り通路の大きさ以下程度にすることができるので、気泡が除湿用絞り装置の絞り通路を通過するときに発生する圧力脈動を低減でき、冷媒流動音を低減することができる。また、除湿用絞り装置の下流側の多孔部材により、除湿用絞り装置の絞り通路を通過した冷媒流の乱れを整流することができるので、流れの圧力変動を抑制し、冷媒流動音の低減ができる。即ち、気泡の微細化により気泡が絞りを通過するときに間欠的に発生する冷媒流動音と、絞り下流で発生する連続的な冷媒流動音の２種類の冷媒流動音を同時に低減することが可能である。また、冷房運転時、暖房運転時の多孔部材での圧力損失は小さくできるので、空気調和機の性能に及ぼす影響は非常に小さくでき、機能維持が図れる。

【００７１】

【発明の効果】本発明によれば、一つの開閉絞り弁を用いるという簡単な構成の除湿用絞り装置で、冷房運転、

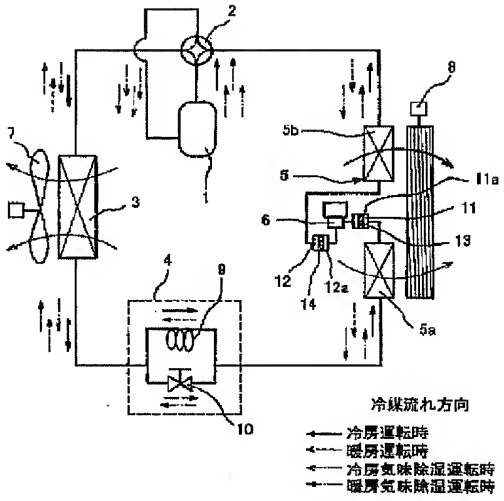
【図３】

図 3



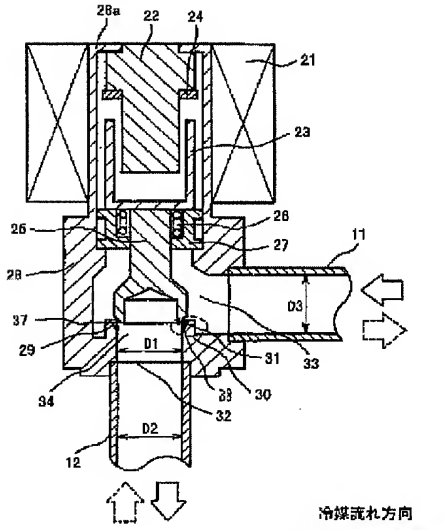
【図４】

図 4



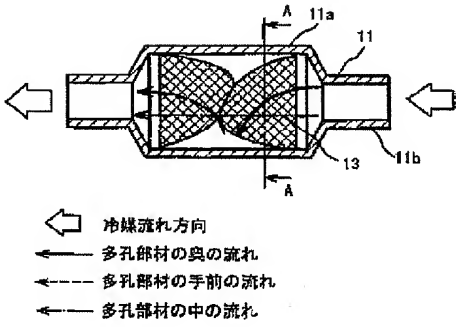
【図５】

図 5



【図６】

図 6



【図７】

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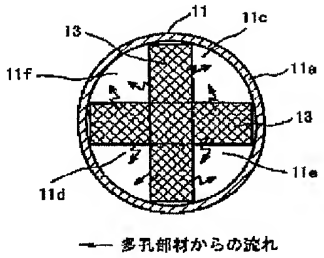
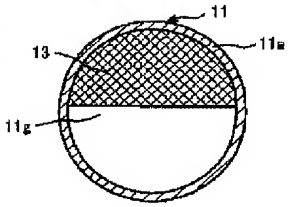


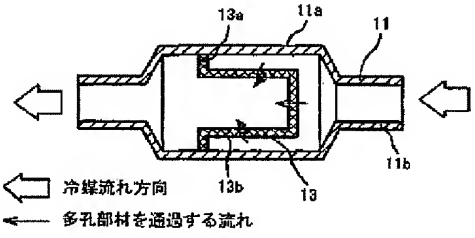
【図９】

図 9



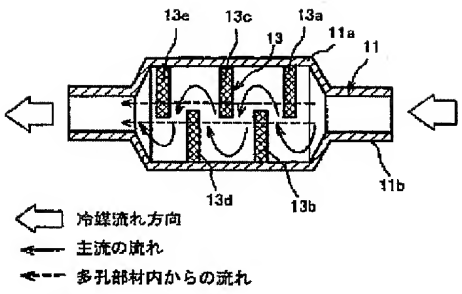
【図１１】

図 11



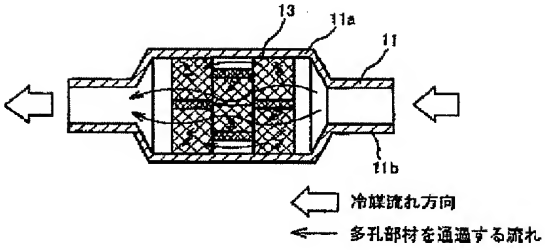
【図８】

図 8



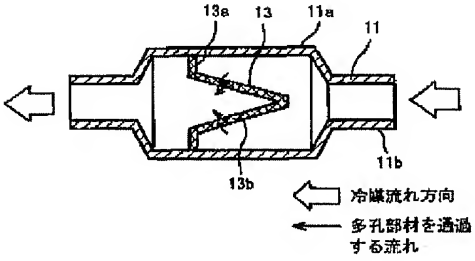
【図１０】

図 10



【図１２】

図 12



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(57)Abstract:
PROBLEM TO BE SOLVED: To obtain an appropriate restricting function easily and stably for a long period by using a restricting device for dehumidification of a simple structure and also to reduce a pressure loss of refrigerant piping in cooling and heating operations while sharply decreasing a flow sound of a refrigerant in a dehumidifying operation.
SOLUTION: The restricting device 6 for dehumidification is constituted of an opening-closing restrictor which is put in a state of opening in the cooling and heating operations and makes a first indoor heat exchanger 5a and a second indoor heat exchanger 5b, divided in two, communicate with each other, while it is put in a state of restriction in the dehumidifying operation and makes the first and second indoor heat exchangers 5a and 5b communicate with each other. An expanded pipe 11a is provided in the portion of the refrigerant piping connected to the device 6 which turns to be on the upstream side in the dehumidifying operation, while a porous member 13 is provided in a refrigerant passage in the expanded pipe 11a.

[Claim(s)]

[Claim 1] An air conditioner that forms a refrigerating cycle by connecting with refrigerant piping a compressor; a heat source side heat exchanger; a user's side heat exchanger thermally divided into two; a collimator for air conditionings which is arranged in between said heat source side heat exchanger and said user's side heat exchanger, and performs wire drawing at

the time of cooling operation and heating operation; a collimator for dehumidification which is arranged in between said user's side heat exchangers divided into two, and performs wire drawing at the time of dehumidifying operation; and a four-way valve which is arranged in between said compressor and said heat source side heat exchanger and said user's side heat exchanger, and switches a flow of a refrigerant; and

wherein the collimator for dehumidification includes an opening and closing throttle valve which is open for free passage between said user's side heat exchangers divided into two at cooling operation and heating operation, and which is closed at dehumidifying operation; and

wherein the refrigerant piping connected to said collimator for dehumidification which installs a line-size limb to refrigerant piping which serves as the upstream side at least at the time of dehumidifying operation, and porous member is installed to the line-size limb in a refrigerant path.

[Claim 2] An air conditioner that forms a refrigerating cycle by connecting with refrigerant piping a compressor; a heat source side heat exchanger; a user's side heat exchanger thermally divided into two; a collimator for air conditionings which is arranged in between said heat source side heat exchanger and said user's side heat exchanger, and performs wire drawing at the time of cooling operation and heating operation; a collimator for dehumidification which is arranged in between said user's side heat exchangers divided into two, and performs wire drawing at the time of dehumidifying operation; and a four-way valve which is arranged in between said compressor and said heat source side heat exchanger and said user's side heat exchanger, and switches a flow of a refrigerant;

wherein the a refrigerating cycle includes a cooling operation which uses the user's side heat exchanger in the cooling side cycle as an evaporator, and uses the heat source side heat exchanger as a condenser; a heating operation which uses the user's side heat exchanger in the heating side cycle as a condenser, and uses the heat source side heat exchanger as an evaporator; an air conditioning tendency dehumidifying operation which uses one of the user's side heat exchangers

in the cooling side cycle as an evaporator and the other one as a condenser, and the heat source side heat exchanger as an condenser; a heating tendency dehumidifying operation which uses one of the user's side heat exchangers in the heating side cycle as a condenser and the other one as an evaporator, and the heat source side heat exchanger as an evaporator;
wherein the collimator for dehumidification includes an opening and closing throttle valve which is open for free passage between said user's side heat exchangers divided into two at cooling operation and heating operation, and which is closed at air conditioning tendency dehumidifying operation and heating tendency dehumidifying operation;
wherein the refrigerant piping connected to said collimator for dehumidification at both sides which install the line-size limbs, and porous members are installed to these line-size limbs in a refrigerant path.

[Claim 3] An air conditioner that forms a refrigerating cycle by connecting with refrigerant piping a compressor; a heat source side heat exchanger; a user's side heat exchanger thermally divided into two; a collimator for air conditionings which is arranged in between said heat source side heat exchanger and said user's side heat exchanger, and performs wire drawing at the time of cooling operation and heating operation; a collimator for dehumidification which is arranged in between said user's side heat exchangers divided into two, and performs wire drawing at the time of dehumidifying operation; and a four-way valve which is arranged in between said compressor and said heat source side heat exchanger and said user's side heat exchanger, and switches a flow of a refrigerant;
wherein the collimator for dehumidification includes an opening and closing throttle valve having a valve for opening and closing a path for valve itself and a path inside the valve, which is open for free passage between said user's side heat exchangers divided into two at cooling operation and heating operation, and which is closed at air conditioning tendency dehumidifying operation and heating tendency dehumidifying operation;
wherein the refrigerant piping connected to said collimator for dehumidification which installs a line-size limb to an

opening inlet portion to the valve body in refrigerant piping which serves as the upstream side at least at the time of dehumidifying operation, and porous member is installed to the line-size limb in a refrigerant path.

[Claim 4] The air conditioner according to claim 3, wherein the porous member has an aperture smaller than a restriction passage after closing the opening-and-closing throttle valve.

[Claim 5] An air conditioner that forms a refrigerating cycle by connecting with refrigerant piping a compressor; a heat source side heat exchanger; a user's side heat exchanger thermally divided into two; a collimator for air conditionings which is arranged in between said heat source side heat exchanger and said user's side heat exchanger, and performs wire drawing at the time of cooling operation and heating operation; a collimator for dehumidification which is arranged in between said user's side heat exchangers divided into two, and performs wire drawing at the time of dehumidifying operation; and a four-way valve which is arranged in between said compressor and said heat source side heat exchanger and said user's side heat exchanger, and switches a flow of a refrigerant;

wherein the a refrigerating cycle includes a cooling operation which uses the user's side heat exchanger in the cooling side cycle as an evaporator, and uses the heat source side heat exchanger as a condenser; a heating operation which uses the user's side heat exchanger in the heating side cycle as a condenser, and uses the heat source side heat exchanger as an evaporator; an air conditioning tendency dehumidifying operation which uses one of the user's side heat exchangers in the cooling side cycle as an evaporator and the other one as a condenser, and the heat source side heat exchanger as an condenser; a heating tendency dehumidifying operation which uses one of the user's side heat exchangers in the heating side cycle as a condenser and the other one as an evaporator, and the heat source side heat exchanger as an evaporator;

wherein the collimator for dehumidification includes an opening and closing throttle valve having a valve for opening and closing a path for valve itself and a path inside the valve, which is open for free passage between said user's side heat exchangers

divided into two at cooling operation and heating operation, and which is closed at air conditioning tendency dehumidifying operation and heating tendency dehumidifying operation; and wherein the refrigerant piping connected to said collimator for dehumidification at both sides which install the line-size limbs to an opening inlet portion to the valve body in refrigerant piping, and porous members are installed to the line-size limbs in a refrigerant path.

[Claim 6] The air conditioner according to claim 5, which comprises a flange by which said porous member attaches the edge part to inner skin of said line-size limb; and a convex shaped part which projects so that it has an inclined plane in the upstream at the time of dehumidifying operation from the center section.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] The present invention is suitable for the air conditioner which divided especially the use side heat exchanger into two, has arranged the collimator for dehumidification among these with respect to the air conditioner which performs air conditioning, heating, and dehumidifying operation using a refrigerating cycle, and made dehumidifying operation possible.

[0002]

[Description of the Prior Art] A conventional air conditioner is disclosed in JP,2000-346495A (prior art 1). This air conditioner is provided with a compressor, an outdoor heat exchanger, the indoor heat exchanger divided into two, and the first flow control valve that is arranged between an outdoor heat exchanger and indoor heat exchanger. It performs wire drawing at the time of cooling operation and heating operation. The second flow control valve that is arranged between the indoor heat exchangers divided into two, and performs wire drawing at the time of dehumidifying operation. The four-way valve switched to the air conditioning side cycle which leads the refrigerant which has been arranged between a compressor, an outdoor heat exchanger, and indoor heat exchanger, and came

out of the compressor to an outdoor heat exchanger. The heating side cycle led to indoor heat exchanger is connected by refrigerant piping, and the refrigerating cycle is formed. The cooling operation which this refrigerating cycle uses the use side heat exchanger in the air conditioning side cycle as an evaporator, and makes a heat source side heat exchanger a condenser. The heating operation which makes a condenser the use side heat exchanger in the heating side cycle, and uses a heat source side heat exchanger as an evaporator. The air conditioning tendency dehumidifying operation which uses one side of the use side heat exchanger in the air conditioning side cycle as an evaporator, makes another side a condenser, and makes a heat source side heat exchanger a condenser. It has a configuration that switches to the heating tendency dehumidifying operation which makes a condenser one side of the use side heat exchanger in the heating side cycle, uses another side as an evaporator, and uses a heat source side heat exchanger as an evaporator. This collimator is constituted by forming the main valve body and main valve seat of the second flow control valve by porosity penetration material, or being connected to an electromagnetism opening and closing valve and parallel, and arranging a sintered metal inside.

[0003] Another conventional air conditioner is disclosed in JP,11-325655A (prior art 2). By rectifying and uniforming disorder of a refrigerant and controlling transfer of pressure pulsation in the refrigerant piping of the refrigerating cycle of an air conditioner, there are some which vacate an interval in the direction of refrigerant circulation, and were made to carry out plural-lines insertion of the honeycomb pipe which bundled two or more narrow diameter pipes to the refrigerant piping connected to the expansion valve which performs wire drawing for the purpose of reducing generating of noise at the time of air conditioning operation. A porous metal or porosity ceramics is disclosed, instead of this honeycomb pipe.

[0004] Another conventional air conditioner is disclosed in JP,11-51514A (prior art 3). In the dehumidifying operation which dehumidifies while a refrigerating cycle protects the fall of a room temperature, it aims at reducing a refrigerant

flow noise, reducing amount of electricity in use, securing required dehumidification volume, dividing thermally into two the user's side heat exchangers which forms the refrigerant cycle. As the first and second user's side heat exchanger, the collimator for dehumidification being formed between the first and second use side heat exchangers. In the dehumidifying operation, the first user's heat exchanger at upstream side serves as a condenser, and the second user's heat exchanger at downstream side serves as an evaporator, by using the collimator for dehumidification. A collimator for dehumidification comprises the valve port penetrated to the first refrigerant passage that was open for free passage to the first use side heat exchanger, the clear aperture penetrated to the second refrigerant passage that was open for free passage to the second use side heat exchanger, the valve seat in which the third refrigerant passage that connects this valve port, the clear aperture, the valve rod which has a valve portion which performs opening and closing of this third refrigerant passage. This valve rod moves, and the structure of the valve which opens and closes this third refrigerant passage when this valve rod moves is made. When this valve rod closes this third refrigerant passage in contact with this valve seat, the independent restriction passage surrounded on this valve rod and the wall surface of this valve seat is formed. When this valve rod and this valve seat separate and this third refrigerant passage is opened, there are some which are constituted so that the restriction passage which this became independent may make this a part of third refrigerant passage united with this third refrigerant passage.

[0005]

[Problem(s) to be Solved by the Invention] Generally, in an air conditioner, if a refrigerant flows an collimator in the state of vapor-liquid two-phases flow, a refrigerant flow noise will be generated. The loudness level originates in the flow pattern of refrigerant vapor-liquid two-phases flow, and is dependent on the size of the air bubbles contained especially in a flow. Especially, when the size of air bubbles is larger than the size of the restriction passage of an collimator, it

changes, when the air bubbles pass through a restriction passage, and pressure pulsation is generated. This is transmitted in an collimator and emitted as a refrigerant flow sound from an air conditioner. At this time, an intermittent refrigerant flow sound occurs and the amenity is spoiled. In order to reduce such a refrigerant flow sound, the smaller possible one of the air bubbles which pass through the restriction passage of an collimator is good, and it is especially desirable that it is a size below the size of a restriction passage.

[0006] Although the main valve body and main valve seat of the second flow control valve are formed by using a porosity penetration material, and it is considered as a collimator or is considered as the collimator which is connected in parallel with an electromagnetism opening and closing valve, and has arranged the sintered metal inside in the prior art 1, since a wire drawing was given to the circulation part of this porosity penetration material or the sintered metal itself, the technical problem that it may be difficult to obtain a suitable wire drawing corresponding to the applicable air conditioner to the porous member, and the size and number of a hole of sintered metals occurred. Although the size of these holes and dispersion of the number affected the dehumidification performance of the air conditioner greatly, the technical problem that it will be difficult to form uniformly this porous member, and the size and number of a hole of sintered metals, and dispersion in dehumidification performance has occurred. In some main valve body and a main valve seat which are formed by a porous member, there was a possibility that the contact portion of the main valve body and main valve seat might cause modification by years of use. This might cause the technical problem that the amount of throttling might change from the initial amount due to leakage from the converging section. Also when a dirt, such as trash in a refrigerating cycle, has been adhered to the porosity penetration material or a sintered metal and clogging occurred, the technical problem that the amount of throttling will become large has occurred.

[0007] In the prior art 2, it is not indicated at all not about the thing which starts the expansion valve which performs the

wire drawing at the time of air conditioning operation, and starts the collimator for dehumidification which performs wire drawing at the time of dehumidifying operation but about the collimator for dehumidification which performs wire drawing at the time of dehumidifying operation. Since an interval is vacated in the direction of refrigerant circulation and it is made to carry out plural-lines insertion of a honeycomb pipe, a porous metal, or the porosity ceramics in the prior art 2. When it applies to the collimator for dehumidification of the air conditioner in which dehumidifying operation is possible, the pressure loss in this refrigerant piping becomes large at the time of cooling operation and heating operation, and the air conditioning performance and heating performance of an air conditioner fall.

[0008] In the prior art 3, although reduction of the refrigerant flow noise in dehumidifying operation is indicated, since the relation of the flowing size of the air bubbles of refrigerant vapor-liquid two-phases flow and the collimator for dehumidification is not indicated, the factor which can reduce a refrigerant flow noise further is left behind by improving this relation.

[0009] The purpose of the present invention is directed to a collimator for dehumidification having a simple configuration which uses one opening-and-closing throttle valve. Cooling operation, heating operation, and dehumidifying operation being possible, and reducing substantially the refrigerant flow noise at the time of the dehumidifying operation which can obtain suitable wire drawing by being stabilized easily and for a long period of time, and is generated with the collimator for dehumidification. It is in providing the air conditioner which controls the pressure loss of the refrigerant piping at the time of cooling operation and heating operation, and can improve air conditioning performance and heating performance.

[0010]

[Means for Solving the Problem] To achieve the above objects, an air conditioner that forms a refrigerating cycle by connecting with refrigerant piping a compressor; a heat source side heat exchanger; a user's side heat exchanger thermally divided into

two; a collimator for air conditionings which is arranged in between said heat source side heat exchanger and said user's side heat exchanger, and performs wire drawing at the time of cooling operation and heating operation; a collimator for dehumidification which is arranged in between said user's side heat exchangers divided into two, and performs wire drawing at the time of dehumidifying operation; and a four-way valve which is arranged in between said compressor and said heat source side heat exchanger and said user's side heat exchanger, and switches a flow of a refrigerant; and wherein the collimator for dehumidification includes an opening and closing throttle valve which is open for free passage between said user's side heat exchangers divided into two at cooling operation and heating operation, and which is closed at dehumidifying operation; and wherein the refrigerant piping connected to said collimator for dehumidification which installs a line-size limb to refrigerant piping which serves as the upstream side at least at the time of dehumidifying operation, and porous member is installed to the line-size limb in a refrigerant path.

[0011]

[Embodiment of the Invention] Hereafter, embodiments of the present invention is described with reference to the drawings. The same reference numerals in the drawings of each embodiment show the same elements or their equivalents. The air conditioner of each embodiment is installed in buildings.

[0012] The first embodiment of the present invention is described with reference to Figs. 1 to 3.

[0013] At first, the configuration of the air conditioner of the present embodiment is described with reference to Fig. 1. Fig. 1 is a configuration diagram of a refrigerating cycle of the air conditioner of the first embodiment of the present invention.

[0014] Referring to Fig. 1, the refrigerating cycle is formed by connecting a compressor 1, an outdoor heat exchanger 3, a indoor heat exchanger 5, a collimator 4 for air conditioning, a collimator 6 for dehumidification, and a four-way valve 2 by using refrigerant piping. The outdoor heat exchanger 3 serves as a heat source side heat exchanger. The indoor heat

exchanger 5 serves as user side heat exchanger which is thermally divided into two. The collimator 4 for air conditioning is disposed in between the outdoor heat exchanger 3 and the indoor heat exchanger 5, and performs wire drawing at the time of cooling operation and heating operation. The collimator 6 for dehumidification which is disposed in between a first indoor heat exchanger 5a of the indoor heat exchanger 5 divided into two and a second indoor heat exchanger 5b, and performs wire drawing at the time of dehumidifying operation. The four-way valve 2 is arranged in between the compressor 1, the outdoor heat exchanger 3, and the indoor heat exchanger 5, for switching between an air conditioning side cycle and a heating side cycle. The air conditioning side cycle leads the refrigerant from the compressor 1 to the outdoor heat exchanger 3. The heating side cycle leads the refrigerant to the indoor heat exchanger 5.

[0015] The cooling operation which this refrigerating cycle uses indoor heat exchanger 5 in the air conditioning side cycle as an evaporator, and makes the outdoor heat exchanger 3 a condenser. The heating operation which makes a condenser indoor heat exchanger 5 in the heating side cycle, and uses the outdoor heat exchanger 3 as an evaporator. The air conditioning tendency dehumidifying operation which used the second indoor heat exchanger 5b in the air conditioning side cycle as the evaporator, made the condenser the first indoor heat exchanger 5a, and made the outdoor heat exchanger 3 the condenser. It has configuration which can be switched without the heating tendency dehumidifying operation which makes a condenser the second indoor heat exchanger 5b in the heating side cycle, uses the first indoor heat exchanger 5a as an evaporator, and uses the outdoor heat exchanger 3 as an evaporator.

[0016] And the outdoor fan 7 is installed so that outdoor air may be compulsorily ventilated to the outdoor heat exchanger 3. The indoor fan 8 is installed so that indoor air may be compulsorily ventilated to the indoor heat exchanger 5. Operation of this indoor fan 8 absorbs in parallel with the first indoor heat exchanger 5a and the second indoor heat exchanger 5b, the air which came out from now on is mixed, and

indoor air blows off from the indoor fan 8 indoors by it.
[0017] As for the piping member 12 which has the piping member 11 and the line-size limb 12a which have the expanded pipe 11a, the porous members 13 and 14 are installed in the refrigerant flowing path in the expanded pipe11a and the line-size limb 12a. The porous members 13 and 14 are members which the stoma of a large number made from the sintered metal etc. opened, and each stoma has connected and they can let a refrigerant pass here.
[0018] As mentioned above in this embodiment, the compressor 1, the four-way valve 2, the outdoor heat exchanger 3, the collimator 4 for air conditionings, and the indoor heat exchanger 5 are connected by refrigerant piping in order, and the refrigerating cycle is formed. Especially the indoor heat exchanger 5 is divided into the first two indoor heat exchanger 5a and the second indoor heat exchanger 5b, and the piping members 11 and 12 including the porous members 13 and 14 are formed the collimator 6 for dehumidification which makes the feature of this example among them, and before and after that.
[0019] Specifically described in more detail, the four-way valve 2 is with the time of air conditioning / air conditioning tendency dehumidifying operation and heating / heating tendency dehumidifying operation. It is for switching the flow direction of the refrigerant in this refrigerating cycle, a solid line arrow indicates the flow direction of the refrigerant at the time of cooling operation, a dashed line arrow shows the flow direction of the refrigerant at the time of heating operation, a dashed dotted line arrow shows the flow direction of the refrigerant at the time of air conditioning tendency dehumidifying operation, and the two-dot chain line arrow shows respectively the flow of the refrigerant at the time of heating tendency dehumidifying operation. Air conditioning tendency dehumidifying operation is operation which can dehumidify without mainly lowering an indoor temperature, and heating tendency dehumidifying operation is operation which can dehumidify mainly raising a room temperature here.
[0020] As for the collimator 4 for air conditionings at the time of heating operation, the operation which decompresses

a refrigerant respectively is made and this decompression action is kept from arising at the time of dehumidifying operation at the time of cooling operation, so that an endothermic may be effectively performed from outdoor air by the outdoor heat exchanger 3, and so that an endothermic may be effectively performed from indoor air by the indoor heat exchanger 5. For this reason, the main collimator 9 and the two-way valve 10 are making the collimator 4 for air conditionings, and the composition which it comes to arrange in parallel at the time of heating and cooling operation. The two-way valve 10 closes and it is made for a refrigerant to pass the main collimator 9, and at the time of dehumidifying operation, it is controlled so that the two-way valve 10 opens and a refrigerant passes this two-way valve 10. This collimator 4 for air conditionings may be good also as one expansion valve, for example, at the time of cooling operation, in the time of heating operation, it may function as a diaphragm and the expansion valve used in the state of full admission may be sufficient as the case at the time of dehumidifying operation.

[0021] The collimator 6 for dehumidification is in an opened state at the time of heating and cooling operation, serves as a refrigerant passage of a low-pressure power loss, and passes a refrigerant as it is, and acts as a throttle valve at the time of dehumidifying operation.

[0022] The piping members 11 and 12 including the porous members 13 and 14 provided before and after the collimator 6 for dehumidification. When passing the piping member 11 to which the refrigerant stream of the vapor-liquid two phase including the porous member 13, it changes into the flow pattern having contained air bubbles smaller than the restriction passage of the collimator 6 for dehumidification, and is made to flow into the collimator 6 for dehumidification in the time of air conditioning tendency dehumidifying operation. And when passing the piping member 12 to which the refrigerant stream of the vapor-liquid two phase including the porous member 14, it changes into the flow pattern having contained air bubbles smaller than the restriction passage of the collimator 6 for dehumidification, and is made to flow into the collimator 6

for dehumidification in the time of heating tendency dehumidifying operation. The piping member 12 including the porous member 14 rectifies the refrigerant stream which passed the collimator 6 for dehumidification at the time of air conditioning tendency dehumidifying operation, and reduces disorder of a refrigerant stream. And the piping member 11 including the porous member 13 rectifies the refrigerant stream which passed the collimator 6 for dehumidification at the time of heating tendency dehumidifying operation, and reduces disorder of a refrigerant stream.

[0023] As a result, in order to change the air bubbles in refrigerant vapor-liquid two-phases flow into air bubbles smaller than the restriction passage of the collimator 6 for dehumidification and to flow into the dehumidification restriction passage 6 in the porous member 13 or 14 provided in the upstream of the collimator 6 for dehumidification, The pressure pulsation at the time of diaphragm passage can be made small, and a refrigerant flow sound can be reduced. In the porous member 14 or 13 provided in the downstream of the collimator 6 for dehumidification, by rectifying the flow of the vapor-liquid two-phases flow which passed the collimator 6 for dehumidification, disorder of a flow is made small, pressure fluctuation is reduced, and this also serves as reduction of a refrigerant flow sound. Thus, a refrigerant flow sound can be substantially reduced by the synergistic effect of the porous members 13 and 14 installed in the upstream and the downstream of the collimator 6 for dehumidification. As for the size of the hole of the porous members 13 and 14, in order to make an effect large more, it is desirable that it is especially below the size of the restriction passage of the collimator 6 for dehumidification.

[0024] The condenser with which the first indoor heat exchanger 5a and the second indoor heat exchanger 5b radiate heat indoors to the outdoor heat exchanger 3 turning into an evaporator which performs an endothermic from outdoor air in this embodiment at the time of heating operation. At the time of cooling operation, the first indoor heat exchanger 5a and the second indoor heat exchanger 5b turn into an evaporator which carries

out an endothermic from indoor air to the outdoor heat exchanger 3 turning into a condenser.

[0025] At the time of air conditioning tendency dehumidifying operation, the outdoor heat exchanger 3 turns into a condenser like cooling operation, Since the collimator 6 for dehumidification carries out the operation as a throttle valve, the first indoor heat exchanger 5a of the upstream turns into a condenser which radiates heat to indoor air, and the second indoor heat exchanger 5b of the downstream turns into an evaporator which carries out an endothermic from indoor air. When the second indoor heat exchanger 5b carries out an endothermic, indoor air is cooled and dehumidification is performed. Heat dissipation is performed by the first indoor heat exchanger 5a, indoor air is warmed, and comfortable dehumidifying effects are acquired by mixing this cooled air and the warmed air and blowing off indoors so that this air cooling may be compensated.

[0026] At the time of heating tendency dehumidifying operation, the outdoor heat exchanger 3 just like in the heating operation,, it becomes an evaporator and the collimator 6 for dehumidification carries out the operation as a throttle valve, and the second indoor heat exchanger 5b of the upstream turns into a condenser which radiates heat to indoor air, and the first indoor heat exchanger 5a of the downstream turns into an evaporator which carries out an endothermic from indoor air. When the first indoor heat exchanger 5a carries out an endothermic, indoor air is cooled and dehumidification is performed here. Heat dissipation is performed by the second indoor heat exchanger 5b, indoor air is warmed, and comfortable dehumidifying effects are acquired by mixing this cooled air and the warmed air and blowing off indoors so that this air cooling may be compensated. Since the hot refrigerant which came out of the compressor 1 is led to the direct indoor heat exchanger 5b at this time unlike air conditioning tendency dehumidifying operation, the dehumidified air with a high blow-off air temperature can be obtained, and it is effective in dehumidifying operation in rainy season and autumn rain when the atmospheric temperature is comparatively low.

[0027] Fig. 2 is a drawing of a longitudinal section showing the specific example of the collimator 6 for dehumidification of Fig. 1. Referring to Fig. 2, a magnet coil 21, an electromagnetism guide 22, a plunger 23, a shock absorbing material 24, a valve portion 25 constituting rod portion, a spring 26, a stopper 27, a valve body 28, a cylindrical portion 28a, a slitting seat 30, a valve port 31, opening 32, valve chests 33 and 34, and a valve rod end faces 37. The air conditioner using the collimator 6 for dehumidification shown in Fig. 2, in the dehumidifying operation which dehumidifies while a refrigerating cycle protects the fall of a room temperature, is disclosed in JP,11-51514,A for having reduced the refrigerant flow noise, being able to reduce amount of used electricity, and securing the required dehumidification amount.

[0028] As apparent from Fig. 2, the valve body 28 installs two valve chests 33 and 34. The valve chest 33 serves as the high-tension side of a refrigerant at the time of air conditioning tendency dehumidifying operation, and the valve chest 34 serves as the low-tension side of a refrigerant, and the valve chest 34 serves as the high-tension side of a refrigerant at the time of heating tendency dehumidifying operation, and the valve chest 33 serves as the low-tension side of a refrigerant. And the refrigerant piping 11 from the first indoor heat exchanger 5a (refer to Fig. 1) is connected with the valve chest 33. The refrigerant piping 12 from the second indoor heat exchanger 5b (refer to Fig. 1) is connected with the valve chest 34. At the time of air conditioning tendency dehumidifying operation, the refrigerant piping 11 turns into an inlet pipe of a refrigerant, and the valve chest 34 serves as the low-tension side. At the time of heating tendency dehumidifying operation, the refrigerant piping 12 turns into an inlet pipe of a refrigerant, and the valve chest 33 serves as the low-tension side. In this valve chest 33, the valve rod 25 is movably formed to a sliding direction on the drawing.

[0029] The cylindrical part 28a is formed in one, on the drawing, the electromagnetism guide 22 is the same, the stopper 27 is respectively formed in the upper part at the lower part, and

the plunger 23 which was united with the valve rod 25 among these is arranged at the valve body 28. This plunger 23 is making cylindrical and this cylindrical part is arranged between the lobe of the electromagnetism guide 22, and the cylindrical part 28a. The shock absorbing material 24 is formed in the portion which counters the tip part of the plunger 23 in the electromagnetism guide 22, and the portion in which this shock absorbing material 24 of the electromagnetism guide 22 was formed serves as a stopper of another side to the plunger 23. This plunger 23 is energized towards the upper part 22, i.e., an electromagnetism guide, with the spring 26 fixed to the stopper 27. The magnet coil 21 is formed in the outside surface side of the cylindrical part 28a.

[0030] By this configuration, if it energizes to the magnet coil 21, an electromagnetic force will occur between the electromagnetism guide 22 and the plunger 23. The plunger 23 and the valve rod 25 will move to the position with which this electromagnetic force and the energizing force of the spring 26 balanced up and down. What is driven as a drive of the valve rod 25 of a dehumidification throttle valve using a motor, something driven mechanically, something to drive by the pressure control using a temperature sensor barrel may be applied, and something of various configuration can be applied to a drive method.

[0031] On the boundary of the valve chests 33 and 34, the valve seat 30 (dashed line portion in Fig. 2) projected to the valve chest 33 side is formed. The valve chest 34 uses the boundary with the valve chest 33 of the portion of this valve seat 30 as the valve port 31. It uses the terminal area with the refrigerant piping 12 as the clear aperture 32. The tip part of the valve rod 25 is cylindrical shape, having a slightly larger outer diameter than the path of the valve port 31 of the valve seat 30, and the one or more slitting slots 29 are established in the valve seat 30. Any shape of a slitting quirk of this throttle valve is applicable in a V groove or a cylindrical shape slot.

[0032] In this configuration, if it energizes to the magnet coil 21, the energizing force of the spring 26 will be resisted,

the plunger 23 and the valve rod 25 will be depressed by the big electromagnetic force generated between the electromagnetism guide 22 and the plunger 23, and the tip of the valve rod 25 will contact the valve seat 30. At this time, a field surrounded by the slitting slot 29 of the valve rod 25 and the valve seat 30 considers it as the refrigerant restriction passage 37, and opens the valve chest 33 and the valve chest 34 for free passage.

[0033] Since the above-mentioned electromagnetic force will be lost if the energization to the magnet coil 21 is stopped, the valve rod 25 is lifted by the energizing force of the spring 26, and the valve rod 25 leaves it with the valve seat 30. Thereby, the valve port 31 opens, the refrigerant restriction passage 38 is lost and the valve chests 33 and 34 open it for free passage by the valve port 31.

[0034] Thus, as the specific example that makes the structure of a dehumidification throttle valve, the size of the path D1 of the valve chest 34 and the path D2 of the piping 12 are equivalent and more at least, and the size of the path D1 of the valve chest 34 and the piping 11 path D3 being equivalent, at least when the valve rod 25 is fully open. The loss by the pressure decline accompanying the bend to the valve chest 34 from the valve chest 33 arises, and the refrigerant passage of a low-pressure power loss will be formed. The refrigerant restriction passage 38 will be formed in the time of full close of the valve rod 25, and required pressure decline will be brought about.

[0035] And the expanded pipes 11a and 11b are formed in the opening gateway section to the valve body 28, respectively, and, as for the refrigerant piping 11 and 12 of the both sides linked to the collimator 6 for dehumidification, the porous members 13 and 14 are installed, respectively, all over this expanded pipe 11a and the refrigerant passage in 11b.

[0036] These porous members 13 and 14 consist of the flanges 13a and 14a which constitute an edge part, and the convex shaped parts 13b and 14b which it extends in cylindrical shape from the center section of these flanges 13a and 14a, and have a top face part in that tip part. And as for the porous members

13 and 14, the flanges 13a and 14a are attached to the inner skin of the expanded pipes 11a and 12a. The convex shaped parts 13b and 14b are arranged so that it may project in the anti-valve body side.

[0037]Thus, two effects are among the porous members 13 and 14 made into the convex shaped parts 13b and 14b greatly. After passing the porous members 13 and 14 as the first effect first, it is the air bubbles by which minuteness making was carried out uniting again, and keeping them from turning into big air bubbles. Since the distance of the side of the convex shaped parts 13b and 14b of the porous members 13 and 14 and the inner surface of the expanded pipes 11a and 12a becomes narrow, when it is considered as convex towards the valve body side. The binding force to which the refrigerant of the two-phases flow which flows out of the heat exchangers 5a and 5b which are condensers at the time of dehumidifying operation acts on making minute air bubbles which passed the porous members 13 and 14 and flowed into this narrow field becomes large, and there is a possibility of air bubbles colliding and uniting and returning to big air bubbles. On the other hand, by considering it as a convex configuration like the present embodiment at the anti-valve body side. The refrigerant of the two-phases flow which flows out of the heat exchangers 5a and 5b which are condensers at the time of dehumidifying operation passes the porous members 13 and 14, after making of the minute air bubbles, it will flow into a large space, and uniting of air bubbles can be prevented.

[0038] As the second effect, air bubbles are divided with the acute angle edge made to the convex shaped parts 13b and 14b. If the porous members 13 and 14 are made into a convex configuration at the upstream, channeling will occur between the side of the convex shaped parts 13b and 14b of the porous members 13 and 14, and the inner surface of the expanded pipes 11a and 12a. At this time, by the edge part in the convex shaped parts 13b and 14b of the porous members 13 and 14, air bubbles cannot bend acutely, but big air bubbles are torn to pieces and it becomes small air bubbles according to the shearing force by a flow. As a result, big air bubbles can be certainly used

as a fine bubble through two steps, the subdivision with the edge of the porous members 13 and 14, and the minuteness making by porosity.

[0039] Next, the operation at the time of the heating operation of this example, cooling operation, and dehumidifying operation is described.

[0040] At the time of heating and cooling operation, energization to the magnet coil 21 is not performed, but, for this reason, the valve rod 25 is in the state where it was raised, and the valve chests 33 and 34 are open for free passage by the valve port 31 of a large area. At the time of heating operation, from the second indoor heat exchanger 5b, a refrigerant flows into the refrigerant piping 11 through the refrigerant piping 12, the valve chest 34, the valve port 31, and the valve chest 33, and is sent to an opposite direction with an arrow at the first indoor heat exchanger 5a. At this time, as mentioned above, the outdoor heat exchanger 3 (refer to Fig. 1) operates as an evaporator, and these indoor heat exchangers 5 (refer to Fig. 1) operate as a condenser. At the time of cooling operation, from the first indoor heat exchanger 5a, a refrigerant flows into the refrigerant piping 12 through the refrigerant piping 11, the valve chest 33, the valve port 31, and the valve chest 34, and is sent to an arrow direction at the second indoor heat exchanger 5b. At this time, as mentioned above, the outdoor heat exchanger 3 operates as a condenser, and these first indoor heat exchangers 5a and the second indoor heat exchanger 5b operate as an evaporator.

[0041] At the time of air conditioning tendency dehumidifying operation, energization to the magnet coil 21 is performed, and the valve rod 25 in a dehumidification throttle valve contacts the valve seat 30, and closes the valve port 31. The field surrounded in the valve rod 25 and the slitting slot 29 established in the valve seat 30 is formed as the refrigerant restriction passage 38, and the valve chests 33 and 34 are opened for free passage via this refrigerant restriction passage 38. At this time, a refrigerant flows into the same arrow direction as cooling operation through the valve chest 33, the refrigerant restriction passage 38, the valve chest 34, and the refrigerant

piping 12 from the refrigerant piping 11, and is decompressed by these refrigerant restriction passages 38 to a proper pressure. As a result, the valve chest 33 serves as the high-tension side, and the valve chest 34 serves as the low-tension side. And at this time, as mentioned above, the outdoor heat exchanger 3 is a condenser and, in the first indoor heat exchanger 5a, the second indoor heat exchanger 5b as a condenser (reheater) operates as an evaporator (condensator). Thus, although dehumidified in the second indoor heat exchanger 5b, cooling indoor air, it becomes possible to perform dehumidifying operation dehumidified while indoor air will be heated by the first indoor heat exchanger 5a, therefore the fall of a room temperature is prevented.

[0042] At the time of heating tendency dehumidifying operation, energization to the magnet coil 21 is performed in a similar manner. The valve rod 25 in a dehumidification throttle valve contacts the valve seat 30, and closes the valve port 31, the field surrounded in the valve rod 25 and the slitting slot 29 established in the valve seat 30 is formed as the refrigerant restriction passage 38, and the valve chests 33 and 34 are opened for free passage via this refrigerant restriction passage 38. At this time, a refrigerant flows into the same arrow direction as heating operation through the valve chest 34, the refrigerant restriction passage 38, the valve chest 33, and the refrigerant piping 11 from the refrigerant piping 12, and is decompressed by these refrigerant restriction passages 38 to a proper pressure. As a result, the valve chest 34 serves as the high-tension side, and the valve chest 33 serves as the low-tension side. And at this time, as mentioned above, the outdoor heat exchanger 3 is an evaporator and, in the first indoor heat exchanger 5a, the second indoor heat exchanger 5b as an evaporator (condensator) operates as a condenser (reheater). Thus, although dehumidified in the first indoor heat exchanger 5a, cooling indoor air, it becomes possible to perform dehumidifying operation dehumidified while indoor air will be heated by the second indoor heat exchanger 5b, therefore the fall of a room temperature is prevented.

[0043] In this embodiment, by making variable the number of

rotations of the outdoor fan 7, and by changing the condensing capacity in the outdoor heat exchanger 3, alternatively, by making the number of rotations of the compressor 1 variable, and by changing the capability of the compressor 1 to change the condensing capacity in the first indoor heat exchanger 5a, that is, heat release, and the temperature of the blow-off air can be controlled by the indoor fan 8 over the wide range from air conditioning tendency to heating tendency.

[0044] The first indoor heat exchanger 5a and the second indoor heat exchanger 5b, when viewed from the interior of a room, are arranged above and below. The indoor fan 8 divides the indoor air into the first indoor heat exchanger 5a and the second indoor heat exchanger 5b, which are also arranged in forward and backward, when viewed from the interior of a room. Not only it arranges right and left viewed from the interior of a room, but it may be made to pass the indoor air from the second indoor heat exchanger 5b side to the first indoor heat exchanger 5a side, by the indoor fan 8.

[0045] In the embodiment mentioned above, The first indoor heat exchanger 5a and the second indoor heat exchanger 5b were divided into two and used in opened state at the time of cooling operation and heating operation. A free passage is allowed in between them. The collimator 6 for dehumidification is constituted from an opening-and-closing throttle valve which opens for free passage between the first indoor heat exchanger 5a and the second indoor heat exchanger 5b which extracted at the time of air conditioning tendency dehumidifying operation and heating tendency dehumidifying operation, changed into the state, and were divided into two. Cooling operation, heating operation, air conditioning tendency dehumidifying operation, and heating tendency dehumidifying operation are possible at the collimator 6 for dehumidification of the easy configuration of using one opening-and-closing throttle valve. The expanded pipes 11a and 12a are formed in the refrigerant piping 11 and 12 of the both sides linked to the collimator 6 for dehumidification, respectively. The porous members 13 and 14 are installed, respectively, all over these expanded pipes 11a and the refrigerant passage in 12a. Being able to obtain suitable wire

drawing which correspond to the applicable air conditioner by being stabilized easily and for a long period of time, and by doing so the effect mentioned above that the pressure loss of the refrigerant piping at the time of cooling operation and heating operation can be controlled. In addition to that, an area of porous member 13 and 14 can be set large. The size of pores of the porous member 13 and 14 is reduced to make the size of air bubbles in the refrigerant small. Resistance of the refrigerant passing through is reduced by increasing the number of pores. Refrigerant flow noise that occur in the collimator 6 for dehumidification during cooling operation is greatly reduced. Pressure loss of the refrigerant piping 13 and 14 during cooling and heating operation can be suppressed.

[0046] The first indoor heat exchanger 5a and the second indoor heat exchanger 5b were divided into two and used in opened state at the time of cooling operation and heating operation. A free passage is allowed in between them. The collimator 6 for dehumidification is constituted from an opening-and-closing throttle valve which opens for free passage between the first indoor heat exchanger 5a and the second indoor heat exchanger 5b which extracted at the time of air conditioning tendency dehumidifying operation and heating tendency dehumidifying operation, changed into the state, and were divided into two. Cooling operation, heating operation, air conditioning tendency dehumidifying operation, and heating tendency dehumidifying operation are possible at the collimator 6 for dehumidification of the easy configuration of using one opening-and-closing throttle valve. The expanded pipes 11a and 12a are formed in the refrigerant piping 11 and 12 of the both sides linked to the collimator 6 for dehumidification, respectively. The porous members 13 and 14 are installed, respectively, all over these expanded pipes 11a and the refrigerant passage in 12a. Being able to obtain suitable wire drawing which correspond to the applicable air conditioner by being stabilized easily and for a long period of time, and by doing so the effect mentioned above that the pressure loss of the refrigerant piping at the time of cooling operation and heating operation can be controlled. At both times of air

conditioning tendency dehumidifying operation and heating tendency dehumidifying operation, reduction of the refrigerant flow noise in the collimator 6 for dehumidification by the porous members 11 and 12 of the upstream and reduction of the flow sound by the rectification of the porous members 12 and 11 of the downstream can be doubled and attained.

[0047] The expanded pipes 11a and 12a are provided in the opening inlet section to the valve body 28 in the refrigerant piping 11 and 12 which serves as the upstream of the collimator 6 for dehumidification at the time of dehumidifying operation. Since the porous members 13 and 14 are installed all over this expanded pipe 11a and the refrigerant passage in 12a, the expanded pipes 11a and 12a can be formed easily just by expanding the open end of the refrigerant piping 11 and 12 or by shrinking one side from the open end. In these expanded pipes 11a and 12a, from the open end side, the porous members 13 and 14 can be inserted easily and can be installed. Moreover, the collimator 6 for dehumidification can be approached most and the expanded pipes 11a and 11b and the porous members 13 and 14 can be formed at a low cost. The refrigerant piping 13 and 14 prolonged from the expanded pipes 11a and 12a can be taken about easily, and the collimator 6 for dehumidification can be easily installed in the narrow place in an air conditioner.

[0048] The porous members 13 and 14 attach the edge parts 13a and 14a to the inner surface of the expanded pipes 11a and 12a. Convex configuration at their center section at anti-valve body side can prevent formation of bigger air bubbles after passing the porous members 13 and 14, by uniting of the minute air bubbles. Division of air bubbles with the edge of the convex shaped parts 13b and 14b can be promoted.

[0049] The size of the air bubbles contained in the refrigerant vapor-liquid two-phases flow which flows into the collimator 6 for dehumidification is controllable by arranging the piping members 11 and 12 including the porous members 13 and 14 shown in Fig. 1 before and after the collimator 6 for dehumidification shown in Fig. 2. Since the size of the hole of a porous member is especially made smaller than the size of the refrigerant restriction passage 38, the size of the air bubbles into which

the porous members 13 and 14 which changes at the time of passage can be made smaller than the size of a refrigerant restriction passage. Therefore, pressure pulsation can be reduced substantially, and it becomes possible to reduce a refrigerant flow noise rather than the case of independently using the collimator 6 for dehumidification of Fig. 2.

[0050] Next, the modified examples of the porous members 13 and 14 for the first embodiment is described by using Fig. 3.

[0051] These porous members 13 and 14 are provided with the flanges 13a and 14a where their outer edges are attached to inner surface of the expanded pipes 11a and 12a, and the convex shaped parts 13b and 14b which project in conical shape so that it may have an inclined plane in the upstream at the time of dehumidifying operation from that center section.

[0052] According to the first modified example, a distance of the wall of the expanded pipes 11a and 12a and the side of the convex shaped parts 13b and 14b of the porous members 13 and 14 is separated in the center section, when compared with what is shown in Fig. 2. Edge effect becomes small, however, the large face where a flow collides can be taken. Therefore, the effect of the minuteness of the air bubbles by the collision of the flow containing air bubbles can be enlarged at the porous members 13 and 14.

[0053] Next, the air conditioner of the second embodiment of the present invention is described by using Figs. 4 to 12. Fig. 4 is a block diagram of the refrigerating cycle of the air conditioner according to the second embodiment of the present invention. Fig. 5 are the cross-sectional views of the collimator for dehumidification of the air conditioner.

[0054] According to the second embodiment, the expanded pipes 11a and 11b respectively are provided interim portions separate from the collimator 6 for dehumidification of the refrigerant piping 11 and 12 linked to the collimator 6 for dehumidification. During the refrigerant passage inside the expanded pipes 11a and 11b, flat porous members 13 and 14 are respectively installed. These points are fundamentally the same as the first embodiment.

[0055] Also in this second example, the same effect is done

so in the composition which is common in the first example.
[0056] Next, the modified example of the porous member 13 in the second embodiment is described by using Figs. 6 to 12. The modified example of the porous member 13 in this second embodiment is applicable also to the porous member of the first embodiment, and it is also applicable to the porous member 14 of the second embodiment.
[0057] Figs. 6 and 7 are the drawings showing the first modified example of the porous member 13 of the second embodiment. The porous member 13 has a twisting shape in shaft direction of the piping. As shown in Fig. 6, the porous member 13 is attached inside of the piping member 11. A solid line arrow shows the a refrigerant flow in front of the twisted porous member 13, and a dashed line arrow shows a refrigerant flow at inner part of the twisted porous member. Although the main refrigerant flow turns into a flow along a shape of the twisted porous member 13, that is, a flow that leads to the dashed line arrow from a solid line arrow, however, the porous member 13 can let a refrigerant pass through, so that there exist a flow indicated by dashed dotted line. The flow having contained the big air bubbles which pass along this by the flow of a solid line arrow to a dashed line arrow turns into a flow by which air bubbles were minutely divided in the turning stream. By passing through a porous member, the air bubbles are minutely divided, by the flow of the dashed dotted line, and they turn into air bubbles smaller than the size of the restriction passage of the collimator for dehumidification. This arises when refrigerant vapor-liquid two-phases flow collides upon passing through the pores, the big air bubbles are divided into minute air bubbles by the shearing force and flown into the refrigerant stream from a face different from a collided face.
[0058] As shown in Fig. 7, only a part of the cross-sectional area of the porous member 13 is closed among the cross-sectional areas of the piping member 11, and the remaining portion exists as the refrigerant passages 11c, 11d, 1e, and 11f. Therefore, the piping member 11 should have the expanded pipe 11a which is larger than the cross-sectional area of the piping member 13 by the cross-sectional area of the porous member 13 at least.

Since the pressure loss at the time of cooling operation and heating operation does not need be large compared to the case without the porous member 13, there is no need to make the expanded pipe 11a large. The refrigerant passages 11c and 11e are connected with the refrigerant passages 11d and 11f. For this reason, since the function of dividing the air bubbles caused by twisted shape of the turning stream is maintained, the function of an air conditioner can also be maintained. Further, a refrigerant flow noise becomes smaller than the case of independently using the collimator for dehumidification. Note that a quantity of torsion is at least a single twist, that is, more than 180 degrees twist would be effective.

[0059] Figs. 8 and 9 are drawings showing a second modified example of the porous member 13 of the second embodiment. This porous member 13 is alternately arranged in the expanded pipe 11a of the piping member 11. Although the porous member 13 occupies a part of section of the expanded pipe 11a, but not all are covered so that a refrigerant passage 11g is secured. The main flow of the refrigerant at this time is shown by a solid line arrow in Fig. 8. Due to the alternately arranged porous members 13a to 13e, the refrigerant passage meanders, therefore, large air bubbles are minutely divided by the shearing force of the flow, when the flow direction changes. By passing through a porous member, air bubbles are minutely divided by the flow of a dashed line, and they turn into air bubbles smaller than the size of the restriction passage of the collimator for dehumidification. This arises when refrigerant vapor-liquid two-phases flow collides and flows into the porous member 13. Upon passing through the pores, the big air bubbles are divided into minute air bubbles by the shearing force and flown into the refrigerant stream from a face different from a collided face. Since the porous member 13 is arranged alternately, the main refrigerant flow serves as meandering flow, and air bubbles effectively are divided by the shearing force with the edge of the end of the porous member 13. Since this effect will be maintained even if the porous member 13 is clogged, a refrigerant flow noise becomes smaller than the case of independently using the collimator for dehumidification. Since a refrigerant

passage is certainly secured, the function of an air conditioner is also maintainable. At this time, the piping member 50 should have a diameter which is larger than the cross-sectional area of the piping member by an area of the porous member 13 covering the cross-sectional area of the piping member at least. Since the pressure loss at the time of cooling operation and heating operation does not need be large compared to the case without the porous member 13, there is no need to make the expanded pipe 11a large.

[0060] Fig. 10 is a drawing showing a third modified example for the porous member 13 of the second embodiment. This porous member 13 is for acquiring the synergy effect of the porous members 13 of the first and second modified examples. This porous member 13 has a cross shape. The porous member 13 become effective by arranging the porous members 13 along a shaft direction, where each of them is offset at an angle of 45 degrees.

[0061] In arrangement of the porous member 13 of the first to third modified example mentioned above, because not all of the cross-sectional area of the piping where the refrigerant flows is covered by the porous member 13, when a trash or contamination adhere to the porous member 13 to cause clogging, still the refrigerant flows into the collimator for dehumidification. T performance of an air conditioner can be maintained without losing its functions.

[0062] In case of using a sintered metal for the porous member 13 of the first to third embodiments, for example, a torsion-shaped mold and a cross-shaped mold are prepared and manufactured.

[0063] Fig. 11 is a drawing showing a fourth modified example for the porous member 13 of the second embodiment. This porous member 13 totally covers a cross section of the piping. This porous member 13 has a factor of increasing pressure loss due to the porous member 13 during the air conditioning and heating operations. Then, the diameter of the piping member which forms the porous member 13 is enlarged. At the same time, a surface area of the upstream side of the flow direction of the porous member 13 is larger than a cross-sectional area of the piping member 11 at the upstream of the expansion piping member 11,

to form a convex configuration. After passing through the porous member 13, a convex configuration toward the upstream side is formed so that the minute air bubbles may not unite again to result in a bigger air bubble. This is also used for a minute air bubble effect due to collision among a refrigerant flow and the porous member 13.

[0064] Fig. 12 is a drawing showing a fifth modified example for the porous member 13 of the second embodiment. This porous member 13, which has been modified from the porous member 13 of the fourth embodiment, has a convex and conical shape. Thereby, the same effect as the porous member 13 of the first embodiment can be achieved.

[0065] In the refrigerating cycle of the first and second embodiments, an accumulator may be formed in the inlet side (between the second indoor heat exchanger 5b and the compressors 1) of the compressor 1. Depending on the type of compressor 1 or the kind of collimator 4 for air conditionings and the control method in use, the configuration may have a refrigerating cycle with an accumulator. A receiver may be formed between the outdoor heat exchanger 3 and the collimator 4 for air conditionings. Depending on the kind of compressor 1 or the kind of collimator 4 for air conditionings, and the control method in use, it can have the configuration of a refrigerating cycle with a receiver.

[0066] As for types of refrigerant that flows through the refrigerating cycle, a mixed refrigerant (for example, R407C, R410A, and R32) which is one of the single refrigerant of the HCFC22 grade generally used by the air conditioner and the substitute refrigerants which replace HCFC22 from a point of ozone layer depletion or global warming can be used. Especially for high pressure refrigerant such as R410A and R32, owing to the physical properties of these refrigerants, refrigerant flow rate compared to that of R22 is about 60% in R32, and about 70% in R410A. Therefore, pressure loss is reduced, and the pressure loss does not become large even if the porous member 13 is installed before and after the collimator for dehumidification. There is no need to enlarge, for example, the diameter of the piping member where the porous member 13

is installed as large as the case of using R22. In the case of the HFC system refrigerant which is one of the substitute refrigerants, since it does not have a chlorine atom, it has a strong polarity. Therefore, a refrigerating machine oil in use must also have a polarity of dissolving with HFC system refrigerant. However, during manufacturing process or upon installation of the air conditioner, impurities, such as contamination, remain in the refrigerating cycle. These contamination are mostly non-polar substances. A highly reactive impurities at high temperature inside the compressor or additives contained in the refrigerating machine oil reacts to from a sludge which is a non-polar substance. These non-polar substances may deposit in the liquid refrigerant, and may accumulate within a refrigerating cycle. These are most likely to be accumulated at a narrow refrigerant restriction passage. By applying various shapes of the porous member 13 in these embodiments, piping which has arranged the porous member 13 is prevented from clogging, and the function of an air conditioner can be maintained. A natural type refrigerant (HC refrigerants) can be used as the refrigerant. Examples of natural type refrigerant (HC refrigerants) are propane, isobutane, and CO2 (carbon dioxide).

[0067] So far in these embodiments, the air conditioner of a building has been described, however, its application is not limited to this but is applicable to other apparatus requiring dehumidifying operation. In such a case, in general, a heat exchanger in use is not restricted as indoor or outdoor. In this case, an indoor heat exchanger is called the heat source side heat exchanger. An indoor fan is called the user's side fan. An outdoor fan is called the heat source side fan.

[0068] As for compressor types, the similar effect can be acquired by using a constant speed rotor even when a control that changes the rotation number of a compressor is not being used.

[0069] In the present invention, an example of the porous member includes a sintered metal, a foamed metal, a wire gauze (mesh), a honeycomb board, and a porous board.

[0070] As described above, according to the air conditioner

of each embodiment, the collimator for dehumidification which divides an indoor heat exchanger (i.e. an user's side heat exchanger) into two. The collimator for dehumidification is installed in between them to be used at the time of dehumidifying operation. During dehumidification operation, one of them is used as an evaporator of the user's side heat exchanger, and the other one is used as a condenser. In such a refrigerating cycle which performs air cooling, dehumidification, and heating, a piping material including porous member is installed before and after the collimator for dehumidification. The size of pores of the porous member is smaller than the size of the refrigerant restriction passage of the collimator for dehumidification. When a refrigerant passes through the porous member at an upstream side of the collimator for dehumidification, the size of the air bubbles of the refrigerant vapor-liquid two-phases flow becomes smaller than the size of the restriction passage of the collimator for dehumidification. Therefore, pressure pulsation generated upon passing through the porous member of the upstream of the collimator for dehumidification is reduced. Also, a refrigerant flow noise can be reduced. Turbulence in the refrigerant flow passing through the collimator for dehumidification can be rectified by the porous member at the downstream of the collimator for dehumidification. Pressure variation of the refrigerant flow is controlled and the refrigerant flow noise can be reduced. That is, two kinds of refrigerant flow noises can be reduced at the same time, namely, the refrigerant flow noise intermittently generated upon passage of the minute air bubbles, and the refrigerant flow noise continuously generated upon the downstream side. Moreover, the pressure loss in the porous member at the time of cooling and heating operations can be set small. An influence which it has on the performance of the air conditioner is minimized, and its functional maintenance is attempted.

[0071]

[Effect of the Invention] According to the present invention, as for the simple collimator for dehumidification that uses one opening-and-closing throttle valve, the cooling operation, heating operation, and dehumidifying operation are possible.

At the same time, throttling is readily obtained and stabilized for a long period. In addition to that, substantial reduction of the refrigerant flow noise at the time of the dehumidifying operation is enabled. Pressure loss of the refrigerant piping at the time of cooling operation and heating operation is suppressed. In this way, air conditioning having improved cooling and heating performances is obtained.

[Brief Description of the drawings]
[Fig. 1] A block diagram of the air conditioner cycle for the first embodiment of the present invention.
[Fig. 2] A cross-sectional view of the collimator part for dehumidification of the air conditioner.
[Fig. 3] A cross-sectional view of the collimator part for dehumidification having a modified example of the porous member of the air conditioner.
[Fig. 4] A block diagram of air conditioner cycle of the second embodiment of the present invention.
[Fig. 5] A cross-sectional view of the collimator part for dehumidification of the air conditioner.
[Fig. 6] A cross-sectional view of a line-size limb showing the first embodiment of the porous member of the air conditioner.
[Fig. 7] A cross-sectional view A-A of the line-size limb.
[Fig. 8] A cross-sectional view of a line-size limb showing the second embodiment of the porous member of the air conditioner.
[Fig. 9] A central sectional view of the line-size limb.
[Fig. 10] A cross-sectional view of a line-size limb showing the third embodiment of the porous member of the air conditioner.
[Fig. 11] A cross-sectional view of a line-size limb showing the fourth embodiment of the porous member of the air conditioner.
[Fig. 12] A cross- sectional view of a line-size limb showing the fifth embodiment of the porous member of the air conditioner.
[Description of Notations]
compressor 1
four-way valve 2
outdoor heat exchanger (heat source side heat exchanger) 3

collimator for air conditionings 4
indoor heat exchanger (user's side heat exchanger) 5
first indoor heat exchanger 5a
second indoor heat exchanger 5b
collimator for dehumidification 6
outdoor fan 7
indoor fan 8
main collimator 9
two-way valve 10
piping member including porous member 11, 12
expanded pipe 11a, 12a
porous member 13, 14
electromagnetism coil 21
electromagnetism guide 22
plunger 23
shock absorbing material 24
Valve rod (valve portion) 25
spring 26
stopper 27
valve body 28
slitting slot 29
valve seat 30
valve port 31
clear aperture 32
valve chest 33, 34
piping inside diameter D2, D3
expanded path of in the collimator for dehumidification D2a, D3a